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Photo - Piare Lal

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* * *

DEVELOPING DATABASE FOR MANAGEMENT OF STRIP-FORESTS

J.K. RAWAT*

Introduction

Strip-forest is a term used for the crop of forest trees raised on narrow land strips of varying widths along roads, canals, railways, drains, bunds or embankments and other linear features, usually owned or managed by government. The plantations have played a crucial role in mitigating the deficiency of timber, fuelwood and other forest produce in States, such as Punjab and Haryana, which are deficient in natural forest resources.

The strip-forests are geographically scattered and hence, prone to damage and pilferage. At the same time, since these are generally along motorable roads, surveillance of plantations is quick and convenient and frequent patrolling enables efficient protection from damage or pilferage. In addition, a record of inventory of growing stock is kept by carrying out enumeration of trees growing along the strips which, besides other uses, helps in protection. The enumeration of trees, an important activity peculiar to the strip-forests, generates profound data which can also be developed into a database and can be utilised for better management of strip-forests. This paper presents a possible design of such a database.

Enumeration of Trees

Enumeration of trees implies numbering, measuring and recording of trees. According to the enumeration rules adopted by Haryana Forest Department (Singh, 1985), the girth of all trees down to 45 cm dbh is measured. Each tree is blazed for a number to be painted on it. The numbering is done for each kilometer and for each side of the strip separately. The record of trees is kept in enumeration registers. Enumeration of each strip is done afresh after every five years.

The information recorded for each strip in separate columns include : kilometer number, side (left or right), tree number, old tree number (as per previous enumeration), species, girth (in cm at breast height), condition of tree (e.g. hollow, top broken, etc.) and disposal of tree (on account of fellings or damage or natural calamity). An abstract of number and volume of trees as per species and girth classification is computed for each kilometer, and also for the whole strip, and is entered in the enumeration register at the end of the strip section.

Although, a large amount of such elaborate data are created and maintained, unfortunately these are kept on paper only. The main use these are being put to is to monitor the growing stock and to keep a check on the field staff. Any other manual query or analysis of data is quite cumbersome and prone to error. Such data, if available as a database in electronic form, can be of immense use in inventory planning, resource management and in developing a

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Geographical Information System (GIS) for decision making. The desired information can be obtained promptly and efficiently at the divisional office or the headquarters by the decision makers.

The Database

A proper database of growing stock along the strip forests can provide answers to certain queries often put to the Forest Department and can help in conducting scientific studies or socio-economic analysis. Some of the possible applications of such databases are :

1. Information of growing stock pertaining to species and class, for any geographical region.
2. Details of growing stock along any particular type of strip-forest, such as "village approach roads", "drains", etc.
3. The number and location of large sized trees of desired species, needed for making preliminary selection of *plus* trees.
4. In order to obtain permission for removal of strips under Forest Conservation Act, information about the number and volumes of trees involved is required. With the database, such information can be readily obtained. In fact, benefit cost analysis of different scenarios, such as widening only on one side of the strip or both sides, can be conducted.
5. The local volume tables for different species are applicable to only small geographical areas where the trees may have a particular form. For example, volume tables will be different for dry and wet regions or for single-row and multiple-row plantations. In practice, the volume tables continue to be modified and new tables are developed. These changes can be incorporated in the database very easily without having to recast the abstracts of the related growing stock in the enumeration registers.
6. Considering the fact that most of the trees planted are of fast growing nature, even 2 or 3 year old data may introduce substantial error in volume estimations. Using a suitable tree growth equation or table in the database, and together with information on age of the crop at the time of enumeration and the date of enumeration, an accurate picture of growing stock can be obtained on a periodic basis.
7. Growing stock database, together with other geographical data, can be used for developing a GIS for the given region. Silvicultural and socio-economic studies can be conducted to identify regions of difficult site conditions or acute biotic interference which may require certain specific action.

The proposed Database Design

The following steps were taken as guidelines to develop a logical design of the proposed database :

1. Entities (i.e. objects for which data items are collected or stored) of the data were determined. These included entities such as trees, strip-forest, beat, tree class, tree volume, etc.
2. Attributes (i.e. data items that characterise an entity) associated with each entity were determined.
3. Unique identifier(s) or key attribute(s) of each entity was determined.
4. Base table for each characteristic entity was created and it was ensured to include foreign keys to link other entity tables.
5. The tables or relations were normalised (Awad, 1994) by ensuring that :

(i) Repeating groups of attributes were removed so that all attributes of a table contain only one value per row,
(ii) Part key dependencies (in case of composite primary key when a non-key attribute is not fully functionally dependent on the primary key) are removed; and
(iii) Non-key items dependent on each other (transitive dependencies) are removed.

Applying the above techniques to the growing stock database, together with the existing information on organisational and administrative set-up in the state, and output desired from the database, a number of relations are proposed. Although, the process of normalisation creates additional entities and relations which may make access of various attributes in the database somewhat slow. Its maintenance becomes easy and efficient.

The relations proposed in the database, along with their attributes, are shown below: (the key attribute is underlined) :

Trees (STRIP-ID, TREE-NO, SPECIES, GIRTH, OLD-NO, CONDITION, REMARK)
(This table will contain data of enumeration register)

Strip-ID (STRIP-ID, STRIP-NAME, SIDE, KM)
(With this table, an identification for each kilometer of a strip-forest for each of its sides, where applicable, will be created. A value of 'x' for KM implies the strip between km x and x+1)

Strip (STRIP-NAME, CATEGORY, SUBTYPE, FIRST-KM, LAST-KM)
(This table will give a list of all strip-forests in the state. CATEGORY and SUBTYPE describe the strip. Where the strip originates within the state, the FIRST-KM will be 0)

Beat (BEAT-ID, BEAT-NAME, STRIP-NAME, KM-START, KM-END)
(This table will give all strip-forests included in a particular beat)

TR-Age (STRIP-ID, YR-PLANTED, YR-ENUMERATED)
(This table will give the year of planting and year of enumeration for each km strip)

Block (BLOCK-ID, BLOCK-NAME, BEAT-ID)

Range (RANGE-ID, RANGE-NAME, BLOCK-ID)

Division (DIVISION-ID, DIVISION-NAME, RANGE-ID)

Circle (CIRCLE-ID, CIRCLE-NAME, DIVISION-ID)
(These four tables describe the usual organisational structure in the state forest department)

TR-Class (CLASS, LO-GIRTH, HI-GIRTH)
(This table give the definition of girth classes of trees. Comparing GIRTH from table TREES with the lower and upper limits, LO-GIRTH and HI-GIRTH, each tree can be allocated to a particular class)

TR-Volume (SPECIES, CLASS, VOLUME)
(This table contains the information on local volume tables of different species)

TR-Growth (SPECIES, CLASS, GR-RATE)
(This table contains growth rates of tree girths for different species and classes)

TR-Removal (STRIP-ID, YEAR, TREE-NO)
(This table contains the information on trees removed from a strip during any particular year)

A number of relational database software can be used for this purpose. In the present organisational set up of the State Forest Departments, the divisional office is the nucleus of information collection and

onward transmission. It is also the lowest level where adequate infrastructure of office personnel exist who can be easily trained to handle computer hardware. The divisional forest officer or a senior official in the divisional office can be made responsible for security and handling of database in the office and may function as the "database administrator" (DBA). The database created at the divisional level needs to be transmitted to the circle and headquarter levels. It does not require constant updating and, hence, online processing is not necessary. Data updating and modification can be done, say, on quarterly basis through batch processing. Since time is no constraint, low cost manual communication can be used which involves sending of information on floppy disks. As the computer facilities in a office will be used by a number of users, the DBA should ensure integrity of data. Besides storing on hard disk, backup copies of database on floppies should be made and stored in safe custody. For security purposes again the database carrier should preferably be the DBA himself.

Conclusion

This paper presents a case for more effective and efficient use of existing inventory data of strip-forests. Suggestions have also been made as to how the database be designed and handled. This, however, is only a preliminary plan of the proposed growing stock database. A professional system analyst and designer can build on this basic design. Such database can serve as useful module in a comprehensive forest inventory database at the national level. as and when it is developed.

SUMMARY

In several states the trees growing in the strip-forests (i.e., such linear features as roads, canals, rails, drains and bunds) are enumerated (i.e., numbered) and these voluminous records of growing stock exist in the form or enumeration registers. In this paper, a case for conversion of these data into a database is presented. A suitable design for the database is proposed and suggestions are made as to new it can be handled by the State Forest Department.

पट्टी वनों का प्रबन्ध करने के लिए आंकड़ों का आधार तैयार करना

जे०के० रावत

सारांश

कई राज्यों में पट्टी-वनों (अर्थात् सड़कों, नहरों, पटरियों, नालियों और बाँधों जैसी लंबी रेखीय जगहों) में उग रहे वृक्षों की गणना की गई है । (अर्थात् उन पर अंक लगाए गए हैं) और गणना पंजियों के रूप में इन वृक्षों के विशाल आलेख उपलब्ध हैं । प्रस्तुत अभिपत्र में इन आंकड़ों को आंकड़ा आधार में परिवर्तित करने की बात प्रस्तुत की गई है । आंकड़ा आधार बनाने का उपयुक्त आकल्प प्रस्तावित किया गया है तथा कुछ सुझाव यह बताने के लिए दिए गए हैं कि इन राज्यों के वन विभाग इन्हें किस तरह से उपयोग में ला सकते हैं ।

References

Awad, E.M. (1994) *System Analysis and Design*. Galgotia Pub. (P) Ltd. New Delhi. 524 pp.

Curtis, G. (1989) *Business Information Systems (Analysis, Design and Practice)*. Addison-Wesley Publishing Co., England. 576 pp.

Singh, Mohinder (1985). *Working Plan of strip-forests of Ambala and Morni-Pinjore Divisions*. Haryana Forest Department, Chandigarh, 254 pp.

DYNAMICS OF CURRICULAR CHANGES IN INITIAL INSERVICE EDUCATION AND TRAINING OF INDIAN FOREST SERVICE

P.N. RAY*

Introduction

Forestry is an applied science of multi disciplinary nature comprising biological principles, quantitative approaches through which technologies and practices are developed to manage forest resources. Unlike most other countries due to historical reasons forestry education in India did not develop through university system. Ninety seven per cent of Indian forests are owned by public of which 85% are administered by State Governments (Anon., 1992). Traditionally, with a view to economy and efficiency, to ensure implementation of integrated policies and planned programmes throughout the country and to guard against growth of unemployment, forestry education remained centralized within the Governmental system (Anon., 1952). It is largely accepted at national level that persons of proven academic calibre and attributes are the best to man public services. Accordingly forest personnel for higher echelons of the service after recruitment were trained in erstwhile Indian Forest College (IFC) established in 1938. Subsequently after revival of Indian Forest Service (IFS) in 1966 training continued in IFC upto 1987. IFC was upgraded to the national level institute and was renamed as Indira Gandhi National Forest Academy (IGNFA). Implicit objective in the transformation was to bring about qualitative improvements in forestry education and training. Over the years the changing complexion of the sector, intricacy of the profession and job requirement essentially needed fundamental transformation in the education and training curriculum in IGNFA. Recently such changes have been implemented in IGNFA with a fairly comprehensive sandwich pattern course model to bring about overall qualitative improvement of professional forestry education. This paper aims to highlight the issues necessitating the change, growing complexities in forestry profession, rationale behind the planned transformation, critical components of the curriculum revision, salient aspects of the revitalization and the modified educational strategies.

Forestry as a Profession and Growing Complexities

Kennedy (1985) defined forestry as "a profession required to manage the forest resources to provide a satisfactory amount and mix of social values for clients living, while protecting these values and use options for future generations". Conceptually it follows that forests are for the people and sustainable management of the resource for the society should be the esteemed goal of foresters. But implementation of these principles are becoming difficult due to growing complexity of management scenario.

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Society is now prioritizing "services" rather than "goods" from forest. Increased public scrutiny and greater accountability in resource management are appearing on the scene. Also simultaneously ever-increasing biotic pressure, soaring demand for forest produce, conflicting demand of land use and for resource sharing are confounding the problem (Ray, 1994).

Appropriate education and training of the new entrants to the service is of paramount importance to achieve the goals of National Forest Policy (NFP). The role of IFS, the premier forest service in the country is to manage, conserve and develop the forest resources of the country; the members have to provide technical inputs, formulate plans, implement policies, guide the subordinate staff at all levels, administer developmental schemes of the Government, having interface with government sister departments and public representatives. The members need awareness, accountability, commitment, in-depth conceptual knowledge of forestry, conservation strategy, managerial skill, analytical capability, administrative acumen and leadership qualities. Like other Civil Service members forest officers have to perform duties within the existing socio-cultural framework. Conflicting pressures of dictates of the profession, bureaucracy, fast changing socio economic priorities, intricacies of forests as a dynamic system, present extremely complex milieu for them.

The need for Curricular Change

The contribution of forestry profession to the general well being of people, role of foresters and need of appropriate training are being critically examined worldwide (Anon., 1991). It is a commonly shared view that to meet the challenge of the day radical changes in education and training of forestry are needed. In the Indian perspective the situational need was succinctly summarised as "While the technological part of the training has served well in the past, there is widely accepted belief that the forest officers need to develop a perspective of their job relating to the social needs of the people dependent upon forestry for their sustenance" (Anon., 1983). It is also opined (Anon., 1989) that "today's forester therefore not only needs scientific knowledge and wider range of technological skills but also more persuasive and problem solving approach". Criticism has often been raised that the pattern of education and training in forestry in IFC is "anachronistic, fastidious and is of classical nature". The basic structure of forestry curriculum drafted by Mr. E.C. Mobbs, founder Principal of IFC in 1938 had been more or less retained although it was revised in 1961, 1971 and 1983 incorporating cosmetic changes. The curriculum hitherto had been built mainly on the concept of timber primacy in management of forests. Though the essential field orientation of forest science had although been recognized, there was no provision for "on-the-job-training" aiming at effective integration of practice with theory, field familiarisation and comprehension about socio-economic milieu. However, such assignment formed a part of service probation, but was heterogeneous and was alleged to be diluted due to lack of training inputs. Neither was there any opportunity of closely monitored and supervised field training programme which would inculcate the spirit of independent learning. Human and integrative skills are better acquired in working environment, but such opportunity did not exist in the existing programme. Also it was largely felt that two years continuous package generated demotivation among the

probationers, who are generally of advanced age. The existing didactic and rigid programme with "drill" approach was proved to be archaic in rapidly transforming management scenario. Moreover it was emphasized that by involving the clientele (the State Forest Departments) in the training process the endeavour would be more meaningful and the role of the Academy as a national resource center would be better appreciated. The link between training of IFS and other levels would be established. Finally changes in structure and contents of educational packages, training strategy and methodology were essential in view of ever increasing volume of knowledge, expectation of the society, entry and terminal behaviour of the probationers. Views and opinions of thinkers and doers, professionals, conservatives, administrators, theorists, pragmatists, education innovators - all suggested material changes in education and training curriculum of IGNFA.

Critical Components of Curriculum Revision

Eisner (1971) defines curriculum as " a series of planned events that are intended to have educational consequences for students". The term in its latin root connotes "runway of course which one runs to reach a goal". Curriculum goal is decided by competent committee within the broad setting of community demands. Education translates these goals to instructional process within chosen plan of instruction. Curriculum has a wider dimension. It encompasses ideas, beliefs, values and cultural aspects of society on the discipline of learning. Furthermore, curriculum may be (1) formal which covers a fixed educational and training package, (2) informal when it includes extra curricular requirements intended to achieve desired level of performance and (3) hidden - dealing with aspects related to ethics, values, morals of specific discipline of education. Curriculum of a professional institute will differ from that of a university - to a degree that university system differs from mandate of the institute. Indeed, like any professional science, forestry education and training programme should have relevance and applicability in the spatial and temporal context of forestry development scenario. In this context salient aspects are presented as follows :

Social dimensions of Forestry : During the last decade there has been an increasing realisation that in achieving goals of sustainable development, social dimensions of forestry have crucial role. Natural resources and environmental conservation are implicitly linked with economic plight of the people. Perpetuation of poverty and denial of essentials to communities dependent upon natural resources decrease the chance of conservation in the long run. Westoby (1987) emphasised the view that "forestry is about trees only so far as they serve the needs of people". Forestry in developing countries should have emphasis on alleviation of poverty and peoples dependence on the resources for their livelihood. Intensified practice of forestry in social context and using it as a vehicle of rural development is stressed. In the perspective of rapid socio-economic transformation the curricular development and their continual revision must reflect the dynamic and changing realities of society. Also there is a growing belief in education that applied sciences should be studies in relation to their social consequences. Forestry must have appropriate perception, ensure sustained flow of benefits to the broadened range of

clientale and promote people's participation in the endeavour. Curriculum must provide for sensitizing learners to such social issues. Recommending social science input in probationer-education of IFS, Mutch *et al.* (1991) emphasised that learners must distinguish in rural people the key difference in regard to socio-economic stratification of rural society, should have perception of issues of rural poverty, livelihood of rural poor, implication of environmental degradation on rural sustenance mechanism, rights and concessions, land reforms, and management of common property resources. Thus social science inputs span a wide range of subjects.

However, subject definition like social forestry, tribal welfare, rural sociology, extension, etc. has a tendency to compartmentalise knowledge. Skills from variety of disciplines should be combined instead (Burch, 1988). People are focal point of the development endeavour. Interrelationship of people and forests should be the more desired field of study.

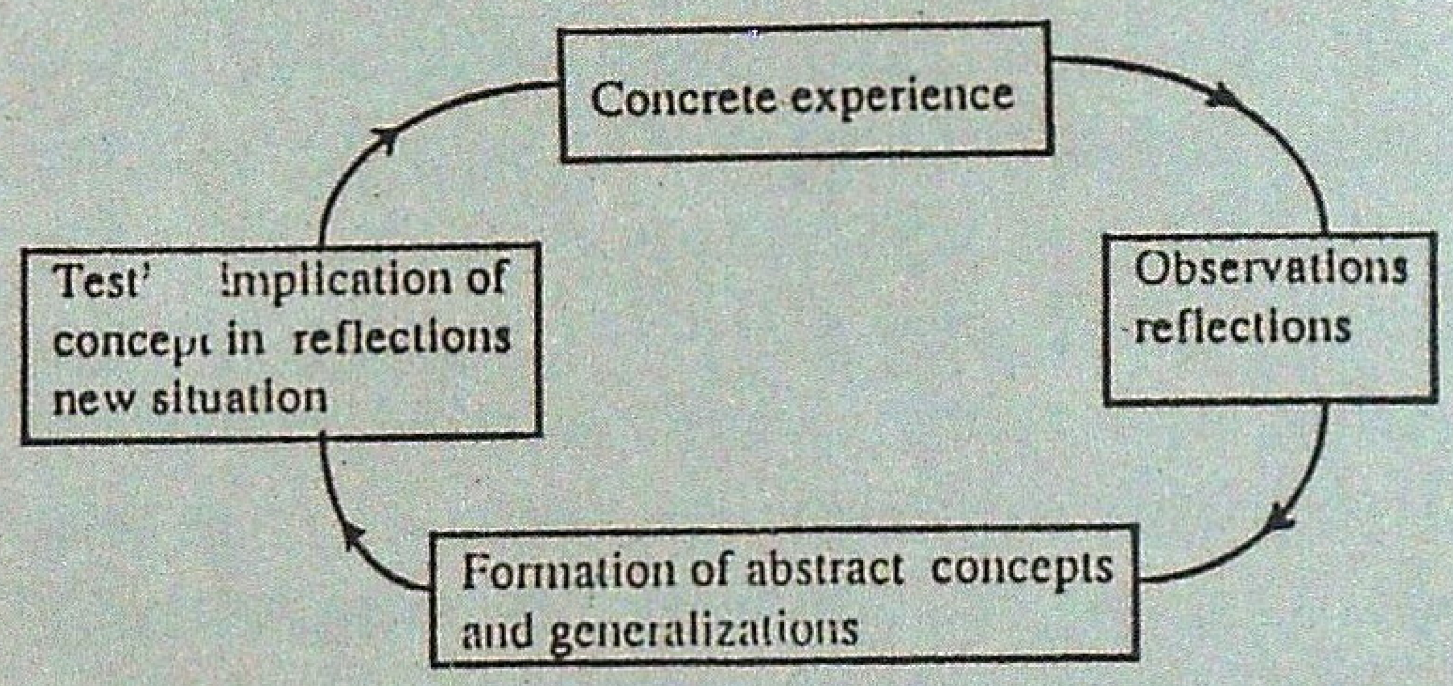
Increasing knowledge base - flexibility : In this rapidly changing world phenomenal growth of knowledge is adding new dimension to every science and attributing new emphasis on older subjects. Concurrently there have been information explosion. Forestry and related disciplines are no exception to such transforming scenario. Under such technological charges curriculum of forestry should also change even if the effective life be small. But in reality it is hard to achieve as curriculum development is a longdrawn process. Nevertheless, criticism often surface about outdatedness, efficiency and relevance of curriculum. Educationists advocate development of a flexible curriculum capable of incorporating the change suggesting the process as ongoing. Inclusion of flexibility will accommodate changes avoiding frequent revision but there are possibilities of too many subjects to be handled. This aspect of overburden can be effectively tackled by attributing varying degree of emphasis (subjects one must know, should know and could know) and definitely through changes in instructional strategy.

Promoting autonomous learning, spirit of cooperation and communication skill : Forestry curriculum should ensure that learner must have broad background, should know how to obtain information and how to apply it in new situation. In this context curriculum inputs motivating to be autonomous learners are essential. In the present perspective study beyond academy is indispensable. Thus the learners must learn how to learn. The learners should be trained to be effective members of an interdisciplinary team; they should have spirit of cooperation. Cooperation implies skill in communication - both oral and written and understanding others views. Also they should have greater appreciation of social and cultural environment in which they will work, a willingness to modify their practices to meet changing demands, and a greater ability to communicate with the public they serve (Bachelard, 1994). They should be articulate speaker, and posses excellent communication skills (Anon., 1986). Unfortunately all these aspects did not receive due importance in forestry training in the past.

Inclusion of work experience in curriculum : Theory of education suggests that it is important to draw upon learners' prior experience and to provide opportunities for them to be engaged actively in what they are learning. Reflection learning - the branch of education deals with the inner details.

Kolb *et al.* (1974) developed the following model (Fig. 1) emphasizing importance of work experience in learning process:

Fig. 1



Work experience and learning process

The ideology is very relevant for professional science like forestry. Effective integration of practices with theory allows familiarities in field realities, constraints, and perspective view of generalized concepts and their limitations. Learners attain the objective of autonomous overall competence with full comprehension of wider cognitive implications. But experience alone is not enough; the work experience should have definite purpose, be adequately supervised, monitored and guided.

Wider technical role of forestry : Also in recent decades a pronounced decrease in isolationism in land use has been conspicuous. Land use concept, agro-forestry, village wood lots, as opposed to vast expanse of forest reserves are now also the concern of forestry. An approach to integrate agriculture and forestry with some understanding of basic agrarian system is necessary. Forestry management is system management, and it should recognise the totality of social, biophysical and economic factors affecting decisions (Behan, 1990). Cortner (1992) opined that "curricula should have a broader resource focus and not narrowly focussed on timber or range and they should produce critical thinkers and problem solvers not just "biological technocrats". FAO (Anon., 1986) stressed that forestry courses to be changed to include ecological and environmental subjects, economics, management and the social sciences.

Recent global trend in forestry education : Worldwide forestry curricula have been subject to extensive reviews in recent decades particularly the last (Roche, 1990). Gilbert (1994) summarised the recent developments and observed that a trend to more interdisciplinarity, greater understanding of social value systems, and more sensitivity to environmental stability are now pronounced in curricula of North America and U.K. More emphasis to silviculture and reduced thrust in logging are also discernible there. Increased attention to economics, harvesting and marketing is noted in Europe. Emerging concept is that "management should be ecosystem based and directed to long term sustainability of all resource values" (Gilbert, 1994). There is increasing realisation at global level that broadened, interdisciplinary nature of study will meet the need of society. Forestry is no longer an isolated stand alone profession. In addition to core disciplines supporting and foundational studies are also necessary.

Problem of subject diversity, university vs academy system : It is now widely accepted that forest managers need not be expert in all the subjects — related to conservation, protection and management of forest resources; it is humanly impossible to acquire such expertise. Another serious problem faced in curricular changes is how an ever growing teaching requirement can be fitted into a fixed span of time? Metadisciplinary approach has been advocated as a pragmatic solution to cope

up with the situation (Westoby, 1987; Bachelard, 1994). A Forester should be generalist in a range of disciplines of forestry with excellent knowledge in a given area of expertise. But the approach is suited only to university system. However, in forestry curricula distinction is made between forest scientists and forest mangers. While the former must receive advanced education further, the latter may prefer to concentrate on practice. True that university curriculum caters the need of both, but the goal of professional academy is to meet the requirements of forest mangers. Unlike university system, it is not possible to offer numerous curriculum alternatives (choice of course units) in a professional academy like IGNFA. Underlying rationale is that all the learners will perform basically same type of job and specialisation can be pursued later. Nevertheless, the educational and training component of forestry professionals of the highest echelons traditionally should have due emphasis on theory, generalized principles, in depth conceptual knowledge with skills in coping and problem solving. It should have more focus on education rather than training (Anon., 1991).

Informal and hidden curricular component : Since IFS has to function within the public service system, curriculum of IGNFA must include an added dimension of training requirements of for All India Service (AIS). Guidelines of draft national training policy (Anon., 1994) provide a "common thread of training objectives that bind together all services, departments, organisations under Governmental system to the achievement of constitutionally defined goal of the state. AIS officers should be intellectually and professionally equipped for holding position that involve policy analysis, capacity to perceive and provide for future trends of issues and events. Training aim at all levels should be continuous attitudinal reorientation in changing organizational ambience to appreciate the imperatives of a democratic society". In addition to imparting of professional and administrative knowledge and skill, inculcation of right attitude imbues the probationer with a sense of commitment which is a *sine qua non* for delivery of desired performance levels. Besides, cocurricular and extra-curricular activities like interactions, counsellor group meetings, participation in community activities should comprise training functions to promote responsiveness, awareness, accountability, commitment instilling *esprit de corps*, leadership, self expression needed for personality development and also noble qualities like strict discipline, integrity, honesty, right conduct, strong sense of duty and high moral character to make them better equipped for a service so demanding in mental stature.

In finne it is worth noting that no curriculum is a complete substitute for sound development policies and programmes; it cannot solve performance problems due to defective organisational structure, faulty procedure and resource constraint.

Methodology adopted

IGNFA recognised that the present curriculum is not in the best future or current interest of the IFS and the Academy's professional reputation. The Government recognised the urgent necessity of curricular change. "Planned change model" was adopted. Impetus of change came from the organisation itself and greater emphasis was on the process of change which was rational and intentional. Administrative leadership was provided by the Director acting as a change agent, entire faculty were motivated and got involved in the

change process. A committee comprising of educationists, alumni, leading professionals, and administrators was formed by the Government of India. Earlier, adopting Delphi technique the opinions on the curriculum were sought from scientists, administrators, educationists and professionals in the field with a view to general assessment of needs and identification of specific problems attempted to be resolved. Metadisciplinary approach was judged to be incompatible with the academy system. Multidisciplinary principle was adopted, instead. The committee reviewed opinions in the perspective of conventional mandate of IGNFA which is to educate the IFS probationers in the science of forestry and train them to be professional public resource mangers. The committee analysed the job

Table 1

Yearwise subjects taught during 2-year postgraduate course in IGNFA

Group	First Year Subjects	Year		Second Year Subjects	Paper
		Paper	Group		
Forestry I	1. Land Management & Soil Conservation 2. Range Management		Forestry I (General)	1. Wildlife Management 2. Environmental Conservation 3. World Forestry	
Forestry II	3. Silviculture Silviculture 4. Mensuration Mensuration Mensuration	I II I II III	Forestry II (Core)	4. Silviculture Silviculture *Viva Voce* in Silviculture 5. Forest Management 6. Working Plans 7. Forest Economics and Valuation	III IV
Earth Sciences	5. Geology Forestry 6. Soil Science		Forestry III	8. Forest Protection 9. Forest Policy and Law 10. Social Forestry 11. Tribal Welfare	
Physical Sciences	7. Surveying 8. Engineering	I	Physical Sciences	12. Engineering 13. Forest Machinery	II
Biological Sciences	9. Botany	I	Biological Sciences	14. Botany 15. Zoology and Entomology 16. Mycology and Pathology	II
Forest Utilisation	10. Forest Utilisation Forest Utilisation	I II	Forest Utilisation Electives *	17. Forest Utilisation 18. Forest Utilisation	III IV

* One of the six subjects (1) Genetics, (2) Forest Statistics, (3) Forest Ecology, (4) Advanced Forest Biometry, (5) Advanced Forest Economics and Valuation, (6) Advanced Wildlife Management.

requirements, knowledge, skill and competencies required for implementation of plans and programmes aimed at achieving goals of NFP comparing with those available under existing curriculum (Table 1). Prime needs for change were identified and recognition of the need provided the committee adequate insight into the way current system is lacking. The committee was of unanimous opinion that the curriculum needed total revitalization in view of the needs already stated. It was decided to maintain the unique blend of education and training input transcending boundary of the term training conforming more towards professional education. Considering the job requirements, training needs and optimality of time the committee was of the opinion that reduction of three years training period is not feasible.

Salient features of the change process

The Government had already approved in principle the proposal of the IGNFA that the curriculum should be restructured in the pattern of the sandwich course model including work experience (on-the-Job-Training) in between course phases (Ray, 1994). Majority of State Governments communicated their consent in favour of the suggested pattern. Rationale behind such model has already been elucidated elsewhere in the paper. The committee desired that curriculum should be developed adopting a sequential learning approach scheduling phases, e.g. induction, professional and advanced. The underlying principle was to build up the course content from relatively basic to increasing complexity. In this context the implications of proposed modifications and alternative plan of action was studies. Proposed phased programme indicating the duration and place of training is presented in Table 2. Feasibility of three suggested plans was tested and problems likely to be encountered were examined. Simulation of three models viz. (i) 4-4-14-8-6, (ii) 4-4-12-8-8, (iii) 4-4-16-8-4 revealed that except model (iii) in both the other two models at a particular period of time there would be three batches in the academy, management of which would pose administrative difficulty. But the committee was also not in favour of extended retention of probationers after on-the-job-training which was considered administratively not feasible. The committee selected the model (i) on optimality criterion as the model provided adequate time for academic and training inputs in the advanced phase as well as was administratively desirable.

Table 2

Sandwich Pattern Course Model

Particulars	Phase				
	I	II	III	IV	V
Months	4	4	14	8	6
Timings	May-August	Sept-Dec	Jan-February	Mar-Oct	Nov-April
Content	Induction	Foundation	Professional	Field	Advanced
Forestry	Course	Forestry	Training	Forestry	
Place	IGNFA*	LBSNAA**	IGNFA	Cadre State/UT	IGNFA

* Indira Gandhi National Forest Academy, Dehra Dun.
** Lal Bahadur Shastri National Academy of Administration, Mussoorie.

All curricular content was subdivided into number of courses after identifying and specifying the subject matter areas to cover. Entry (most are M.Sc and some are Ph.D) and terminal behaviour of probationers were considered and course objectives were developed geared to the overall objective of curriculum. The induction phase aimed at orientation and sensitizing the probationers on forestry both national and global, brining learners of diverse science backgrounds to a common footing through imparting make up courses, and educating them on certain basic sciences. The foundation phase was designed to provide an orientation in economic and socio political infrastructure, general public administration, legal aspects, fundamental ethos of AIS instilling in them right attitudes, values and a wider national outlook. As members of public service they need to appreciate the social and economic goals of the nation and realise the needs and mores of social groups. The professional phase was designed to impart knowledge of sciences, technologies and economies, which control forest production, deal with 'shop front' of forestry and its management. The advanced phase comprised of education in general management, environmental management and forest - people interface and a demonstrated synthesis of all forestry knowledge culminating in a management plan. On-the-job-training formed the important bridging link between professional and advanced phases. It was decided that for monitoring and supervising the phase, broadly the procedure adopted by other AIS academies should be taken as guidelines.

Obviously such introduction of a new model envisaged comprehensive rescheduling of curriculum contents. After general examination of subjects proposed to be covered in different phases the committee decided that :

(i) Ecology should be taught in depth as a separate subject and Silviculture I was merged with it;

(ii) Complex subject like environmental conservation and working plan exercise should be dealt at the advanced phase;

(iii) Contents of entomology, mycology and pathology should be covered under forest protection with much reduced emphasis as probationers should know about symptomatic diagnosis of some of major problems caused by insect vectors and pathogens and report properly to specialists to identify problem and suggest remedies;

(iv) Subject like engineering received very little emphasis as most states/UTs Forest Departments have their own engineering cell or carry out jobs through PWDs as deposit work;

(v) Language training received less weightage due to the fact that its proficiency can only be achieved during working in cadre states and being a part of the milieu;

(vi) Field of study in certain topics were broadened and disciplinary boundaries were dissolved. Geology and Soil Science were integrated and Forest harvesting and wood based industries formed one subject. Scope of wildlife management was broadened which now included bio-diversity conservation. A new module styled 'people and forests' was devised for meaningful inputs of social sciences;

(vii) Quantitative approaches received a great deal of emphasis; Statistics, Geographic Information System and Remote

Sensing, Computer applications were introduced as new subjects. With a view to develop skills in planning, leadership, organisation and control, general management was introduced as a subject;

(viii) Considering "creative destruction", abandoning the outmoded past creating place to new, subjects of no relevance to present context such as forest machinery, world forestry were deleted. Electives were replaced by dissertation;

(ix) Subject definition in many course units had to be revised to enable inclusion of topics of present day concern;

(x) Reorganization on a rational approach was also necessary in case of several sections under silviculture. Scope of forest management was further widened and it included forest economics and valuation.

Proposal of course content (syllabus) in each subject and their weightage in various phases was designed by IGNFA and scrutinised by the author. Subject matter was grouped into discrete units of instructions (courses) which were manageable in size, homogeneous in content and objectives. They were grouped into (i) make up course (ii) core and (iii) peripherals. Detailed course outline were developed and they were organised into a sequence which proceeded from simpler to the more complex concepts while ensuring the interrelationships. In essence, the course outline included basic information, proved facts, and their application to specific situation, concepts and theoretical approaches, analytical skills to problem solving, and promoting critical thinking. Also learners' intended terminal behaviours were expressed in terms of subject matter. Allocation of subjects in phased programme and their relative weights received careful consideration. On the basis of desired depth and comprehension, nature of the subject, availability of time span, the weights were reassigned. Field exercises, designed to enhance integration of skills and ensure professional competencies were strengthened and field tours were further rationalised. Due to the obvious need and essential nature, training in certain skills like (1) swimming, (2) first aid, (3) equitation and (4) weapon use were retained. Phasewise subjects, weightage, lecture hours etc. are presented in Table 3.

The committee stressed that curriculum development is a dynamic process and it should be reviewed from time to time. Inbuilt flexibility was provided by indicating major topics in the course outline, retaining the detailed syllabus for internal use which could be updated/modified from time to time with the approval of IGNFA Board.

Change in Education and Training System

No curriculum however structured and enriched with diverse subjects, can bring about qualitative changes in education and training unless it is aided by inbuilt system of goal directed teaching process with effective instructional design. The design of curriculum at micro level concentrated on specification of learning outcomes, inputs and control mechanism for the courses.

Educationists suggest that curriculum of technical subjects should not emphasize heavily upon didactic approach. Often it is argued that didactic emphasis tend to produce bureaucratic and compartmentalized professionals and such an approach cannot be recommended for certain subjects

Table 3

Phasewise subjects of changed curriculum showing instructional weightage, type, tours, exercises and overall categorisation into groups.

Education and training Phases				
Induction		Foundational	Professional	
Sl. No.	Subject	Subject	Sl. No.	Subject
1.	Elementary Biology/Mathematics (Theory (40*) Practical (50)) (m*)	Public Administration	9.	Soil Conservation & Land Management (40) (c)
2.	Statistics (3) (m)	Management and Behavioural Sciences	10.	Silvicultural Practices (40) (c)
3.	Economics (25) (m)	Basic Economics for Administrators	11.	Silvicultural System (30) (c)
4.	Ecology (55) (m)	Political concepts and Constitution of India	12.	Systematic Botany (Theory (30) Prac. (40)) (c)
5.	Geology & Soil Science (Theory (30) Practical (20) (m)	Law	13.	Forest Biometry (40) (c)
6.	Forest Mensuration (30) (m)	Indian History & Culture	14.	Forest Management (40) (c)
7.	Overview of Forestry — National and Global (20) (m)		15.	Forest Survey (Theory (40) Prac. (50) (p)
8.	Computer awareness (60) (m)		16.	Computer Applications Prac. (10) (p)
			17.	Engineering (Theory (40) Prac. (20))
		Tours	18.	Forest Harvesting & Woodbased Industries (50) (p)
	Advanced Phase	Introductory tour	19.	Non-wood Forest Products (30) (p)
		Hill Tour	20.	Wood Technology (Theory (20) Prac (20)) (p)
25.	Advanced Forest (c) Management (60)	East India tour	21.	Wildlife Management & Biodiversity Conservation (50) (C)
26.	General Management (40) (p)	West India Tour	22.	Forest Protection (50) (c)
27.	Environmental Conservation (20) (p)	South India Tour	23.	Forest Policy and Law (50) (c)
28.	Computer Application Prac. (60) (p)		24.	Computer Applications Prac. (30) (p)
29.	Remote Sensing & GIS (Theory (35) Practical (20)) (p)	**Exercises**		**Qualifying test**
30.	People & Forests (50) (c)	Integrated Watershed Mgt.		Forest Administration (10)
31.	Special Paper (60) (c)	Road Alignment		Regional Languages (30)
		Working Plan		Forest Accounts (10)
				National Language (30

Groups and Constituent Subjects#

Group	Subjects	Group	Subjects	Group	Subjects	Group	Subject
i. Basic Sciences I	1,7	v. Earth Sciences	5	ix. F. Measurement	6,13,29	xiii. Applied Ecology	21
ii. Basic Sciences II	2,3	vi. Forestry I	9	x. F. Management	14, 25	xiv. Social Science	30
iii. Physical Sc.	15,17	vii. Forestry II	22,23	xi. Utilisation	18, 20	xv. Mgt. Science	26, 24
iv. Ecological Sc.	4, 27	viii. Silviculture	10,11	xii. Biological Sc.	12,19	xvi. Project Assignment	31

* Figures and letters in the parentheses indicate lecture hours and type of the subject respectively; c is core, m is make up course and p indicates peripheral.

Subjects within a particular group are represented by respective serial numbers.

specially in adult learning as the learners tend to be isolated in thinking domain (Mutch, 1994). Holistic approach and integration strategies are demanded for resolving many new problems.

Modern teaching methods like participatory/multisensory approach, group tutorials, group discussions, group project work, seminars, programmed self instruction, student directed learning systems, simulation and case study methods, heuristic problem solving method are the requirements of the programme. In case of social and human relation education role playing or socio drama techniques form essential instructional strategies. The curriculum advocated use of recent education technology. More integrated forestry problems are being taught through case studies and project learning.

Conclusion

Revitalization endeavour culminating in a dynamic curriculum that addressed the current and future needs of IFS was an imperative priority for IGNFA. The identification of educational and training need could not be based on detailed job analysis, neither it was necessary; rather the designers in general critically examined the knowledge and skills required to implement plans and programmes according to NFP underpinned the existing shortcoming, transcended their personal experiences, and were guided by the views of the personnel in profession, extending vision to future. Rationale drew heavily upon contemporary educational changes in forestry in global perspective and cardinal principles of educational design. A systematic, comprehensive and result oriented approach was adopted. It is not suggested that the developed curriculum is the best as optimality criteria in this context is hard to define. Nevertheless, the curriculum is reasonably broad based, indepth, highly structured, has inbuilt flexibility at micro level and is compatible with the academy's mandate. It ensures job related knowledge, skill, competencies and right attitude of the new entrants for public service. With growing motivation, improving attitudinal reorientation of learners and sustained emphasis on education strategy, success of the green curriculum bears promise for future.

SUMMARY

Education and training curriculum of Indira Gandhi National Forest Academy needed fundamental transformation to meet the growing complexities of job requirement of IFS. Recently such changes have been implemented with a fairly comprehensive sandwich pattern course with phased programme. Within the general imperatives envisaged in New National Forest Policy training needs were identified. Multidisciplinary approach was accepted in contrast to metadisciplinary principle. Deficiencies of inputs on social, economic, ecological and environmental issues, have been removed. Subjects of less or no relevance to present day context are either assigned less emphasis or deleted. Several new subjects were included. Quantitative approaches received more thrust. Subjects are also reorganized dissolving disciplinary boundaries. The unique blend of education and training orientation in the programme was maintained. The revitalization was made dynamic with inbuilt flexibility providing for incorporating changes. Material improvements in instructional strategy formed integral part of the programme. The new curriculum is expected to meet the current and future needs of the Service.

भारतीय वन सेवा की प्रारम्भिक सेवा-आरम्भ शिक्षा और प्रशिक्षण के पाठ्यचर्या परिवर्तनों की गतिकी

पी०एन० रे

सारांश

भारतीय वन सेवा की कार्यगत आवश्यकताओं की निरन्तर बढ़ रही जटिलताओं का सामना करने के लिए इन्दिरा गाँधी राष्ट्रीय वन अकादमी की शिक्षा एवं प्रशिक्षण पाठयचर्या में मूलभूत रूपान्तरण किए जाने की जरूरत है । विगत में, क्रमिक अवस्थाओं द्वारा काफी विस्तृत ढंग का सन्निविष्ट पाठ्यक्रम अपनाकर ऐसे परिवर्तनों को क्रियान्वित किया गया है । नई राष्ट्रीय वन नीति में प्रस्तावित सामान्य निर्देशों की सीमाओं में रहते हुए प्रशिक्षण की नई जरूरतों को समझा गया है । एक वृहत अनुशासनिक सिद्धांत रखने के प्रतिकूल बहु-अनुशासनिक दृष्टि रखना स्वीकार किया गया । सामाजिक, आर्थिक, पारिस्थितिकीय अथवा पर्यावरणिक प्रश्नों के निवेश की कमियाँ दूर की गई । आज के संदर्भ से कम या बिल्कुल ही संगति न रखने वाले विषयों पर जोर घटाया गया अथवा उन्हें बिल्कुल हटा दिया गया । कई नए विषय उसमें जोड़े गए । मात्रात्मक दृष्टि को अधिक प्रबलता दी गई । अनुशासन सीमाओं को तोड़ते हुए विषय पुर्नगठित किए । कार्यक्रम में शिक्षा एवं प्रशिक्षण झुकाव रखने का विलक्षण मिश्रण पूर्ववत् रखा गया । अन्दर-बनी नमनीयता बरकरार रखते हुए ओजस्विता लाकर सक्रियता लाई गई जिससे उसमें परिवर्तन सम्मिलित किए जा सकें । शैक्षणिक रणनीति में वस्तुगत परिष्कार लाना कार्यक्रम का अविच्छिन्न भाग बनाकर रखा गया । आशा है कि यह नई पाठ्यचर्या इस सेवा की वर्तमान और भविष्य की आवश्यकताएँ पूरी कर सकेगी ।

Rererences

Anon. (1952). *National Forest Policy.* Ministry of Food and Agriculture Resolution, Govt. of India, New Delhi.

Anon (1983). Report of Committee on Orientation of forestry education in India, Govt. of India, New Delhi

Anon. (1986). Forestry Extension Organisation (eds H.A. Hilmi and D. Sim), *FAO For. Paper* **66**, FAO, Rome.

Anon. (1989). *Proc. of National Seminar on Forestry Education and Training in India* 1988. 240 pp. *Society of Indian Foresters*, New Forest, Dehra Dun.

Anon. (1992). *Conserving biological diversity in managed tropical forests.* p 2243. IUCN. Gland Switzerland & Cambridge, UK.

Anon. (1994). *Report of the Working Group on National Training Policy.* Vol I & II. Dept. of Personnel & Training, Govt. of India, New Delhi.

Anon. (1991). Forest Resource Management in the 21st Century : Will Forestry education meet the challenge ? *Symp. Proc.*, Denver, Colorado, 30 Oct - 2 Nov 1991. Soc. Amer. Foresters, Md.

Bachelard, E.P. (1994). Changes to forestry education. *Comm. For. Review,* **73**(2): 94-96.

Behan, R.W. (1990). Multiresource forest management : a paradigmatic challenge to professional forestry. *J. For.* **88**(4):12-18.

Burch Jr., W.R. (1988). The uses of social science in the training of professional social foresters. *J. World For. Resour. Manage.* **3**: 73-109.

Cortner, H.J. (1992). Commitment to change : forestry in the future. Report from the Denver educational symposium. *J. For.* **90**(3):15-17.

Eisner, E.W. (1971). *Conforming Curricular Reform.* Little Brown & Co. Boston.

Gilbert, F.F. (1994). Forestry educations response to changing social values and other resources knowledge. *Forestry Education : New Trends and Prospects,* 51-63 p, FAO, For. Paper 123, FAO Rome.

Kennedy, J.J. (1985). Conceiving forest management as providing for current and future social value. *Forest Ecol. and Mgt.* **13**: 121-132.

Kolb, D.A., I.M. Rubin and J.M. McIntyre (1974). *Organisational Psychology — An experimental Approach,* Prentice Hall, New Jersey.

Mutch, W.E.S. (1994). *Lecture Notes,* Education in Forestry and Natural Resources Management, Univ. of Edinburgh.

Mutch, W.E.S., P.D. Hardcastle, J.W. Morrison and A. Norton (1991). *A Report on Forestry Education & Training.* Govt. of India, Ministry of Environment & Forests, New Delhi.

Ray, P.N. (1994). Forestry Education in Indira Gandhi National Forest Academy : present status and future perspectives. *Forestry Research and Education in India,* 154-162 p, Indian National Science Academy, New Delhi.

Roche, L. (1990). The profession of forestry : a modern synthesis *Proc. Internat. Conference on Forestry Education.* Univ. of Tuscia, Viterbo.

Westoby, J.C. (1987). *The purpose of forests.* Blackwell, Oxford.

Snippets CONFERENCE

15TH COMMONWEALTH FORESTRY CONFERENCE
12-17 MAY, 1997, ZIMBABWE

A good start has been made on preparations for the 15th Conference. Dr Enos Shumba (Conference Secretary General) and Ms Bongi Sibanda (Executive Secretary) and the rest of Zimbabwean Organising Committee (ZOC) have put in a great amount of hard work. They have lined up excellent hotel and conference facilities and a full programme of tours and attachments involving both public and private sector forestry institutions in the country. The ZOC has produced a general information booklet on Zimbabwe, copies of which are available from : The Secretary General, 15th Commonwealth Forestry Conference, Forestry Commission, 1 Orange Grove Drive, PO Box HG 139, Highlands, Harare, Zimbabwe.

TREE GROWTH AND FORAGE PRODUCTION IN BLOCK AND CANALSIDE PLANTATIONS OF I.G.N.P. STAGE-II.

A.K. UPADHYAYA*

Introduction

The Stage-II area of Indira Gandhi Canal Project lies in the North-West part of Rajasthan covering parts of Bikaner and Jaisalmer Districts and extends from 620 RD to 1458 RD (1 RD = 300 m) of the main canal. The area is characterised by almost all adverse climatic conditions having low and erratic rainfall (mean annual being 160 mm), extreme temperature (ranging from 0°C in winters to 50°C in summers), frost in winters and strong winds (30 kmph) during summer, causing sand movement of very high magnitude. Woodland clearance, over grazing, inadequate land use practices and extension of flood irrigation to places having less soil depth causes land degradation of the highest degree.

In a short span of six years, some 40,000 ha area has been planted in Stage-II under various afforestation activities. Two main activities of afforestation viz. Canalside plantations and Block plantations have tremendous forage production potential if managed properly. The growth of six main species which have been planted in these plantations, has been reported along with the quantity of forage produced under these species at regular intervals of six months.

Materials and Methods

Growth data for six species *Eucalyptus camaldulensis, Dalbergia sissoo, Acacia nilotica, Ziziphus mauritiana, Tecomela undulata* and *Prosopis cineraria* was collected from different Block and Canal-side Plantations (Table 1) which were raised in the World Food Programme Division, Jaisalmer. The technique of raising such plantations was same as discussed by Upadhyaya *et al.* (1991). Sample plot size was 0.15 ha and 250 plants were marked for observations of growth data. Plots were average representatives of the whole site. For each species three replicates were taken at different sites and growth observations were recorded for four year old plantations. For calculation of ground vegetation under all species five replicates each of 5 m x 10 m were laid out randomly, all ground vegetation in that plot was cut at ground level and per ha air dried production under different tree species was calculated accordingly. Roots of one plant of *Eucalyptus camaldulensis* and two plants of *Prosopis cineraria* (one of seed origin and one of polybag origin), were excavated to a depth of three meters to study the rooting pattern.

Table 1
Plantations Studied

Type of plantations	Locations
Canal-side plantations	(i) 1406-12RD, LHS, IGMC
	(ii) 1445-50 RD LHS, IGMC
	(iii) 1452-58RD, LHS, IGMC
	(iv) 58 RD, LHS, SMGS
Block plantations	(i) 1325 RD, LHS, IGMC
	(ii) 1406 RD, LHS, IGMC
	(iii) 1410 RD, LHS, IGMC

RD = Reduced Distance (1 RD = 300 m)
LHS = Left Hand Side
IGMC = Indira Gandhi Main Canal
SMGS = Sagar Mal Gopa Shankha

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Results and Discussion

Growth data and forage production at six monthly intervals under different species in four year old plantations are shown in Table 2. Maximum growth in height as well as in girth was attained in case of *Eucalyptus camaldulensis* while minimum growth was attained by *Prosopis cineraria*. Annual sand deposition in unplanted canals is to a tune of 1.758 m^3 per running meter length of canal and plantations effectively reduce sand deposition in canals even at their early stages, Upadhyaya (1991). Therefore, the component of *Eucalyptus* in canalside plantations should be more because it attains more height as compared to other species, hence it forms an effective shelterbelt in checking sand deposition in canals. However the performance of Shisham and Babul are also not bad as compared to *Eucalyptus* if we compare total biomass. The branching in Shisham and Babul increases their biomass almost equal to that of *Eucalyptus*; therefore, these two species should be given priority in Block Plantations.

Out of the three indigenous species which have been planted in command area for the first time, the performance of *Ziziphus mauritiana* was found to be the best and right from the third year it has started producing fruits at the rate of 20 kg per plant. It was believed that *Tecomela undulata* and *Prosopis cineraria* have excessively slow growth rates, Kaul (1977)

Table 2

Growth of tree species and forage production of natural vegetation under different species in command area of IGNP Stage II

Species	Growth parameters	Unit	Months								Total
			6	12	18	24	30	36	42	48	Prod.
Eucalyptus camaldulensis	Height	m	0.80	2.80	4.10	6.90	9.10	11.23	11.90	12.85	
	Collar girth	cm	9	17	23	32	36	43	48	55	
	Forage prod.	t/ha	0.69	0.65	0.42	0.30	0.30	0.23	0.18	0.17	2.94
Dalbergia sissoo	Height	m	0.70	1.35	3.40	5.95	7.20	7.80	8.40	9.90	
	Collar girth	cm	6	11	16	24	29	34	36	40	
	Forage prod.	t/ha	0.70	1.35	2.12	2.22	2.32	1.84	1.53	1.12	13.20
Acacia nilotica	Collar girth	cm	6	17	21	26	28	30	34	37	
	Forage prod.	t/ha	0.71	1.52	2.31	2.43	2.63	2.21	1.72	1.02	14.55
Ziziphus mauritiana	Height	m	0.50	0.93	2.20	2.47	3.90	5.40	5.80	6.10	
	Collar girth	cm	5	7	12	18	23	28	31	34	
	Forage prod.	t/ha	0.71	0.91	1.11	1.56	1.97	1.72	1.21	0.87	10.06
Tecomela undulata	Height	m	0.50	0.69	1.10	1.83	2.60	3.70	4.20	4.56	
	Collar girth	cm	4	6	10	14	20	25	28	30	
	Forage prod.	t/ha	0.72	1.11	1.32	1.91	2.12	1.82	1.41	0.91	11.32
Prosopis cineraria	Height	m	0.40	0.65	1.00	1.75	2.30	3.60	3.75	3.37	
	Collar girth	cm	3	4	8	13	16	20	21	22	
	Forage prod.	t/ha	0.72	1.76	3.64	4.42	4.74	4.85	5.13	5.34	30.60

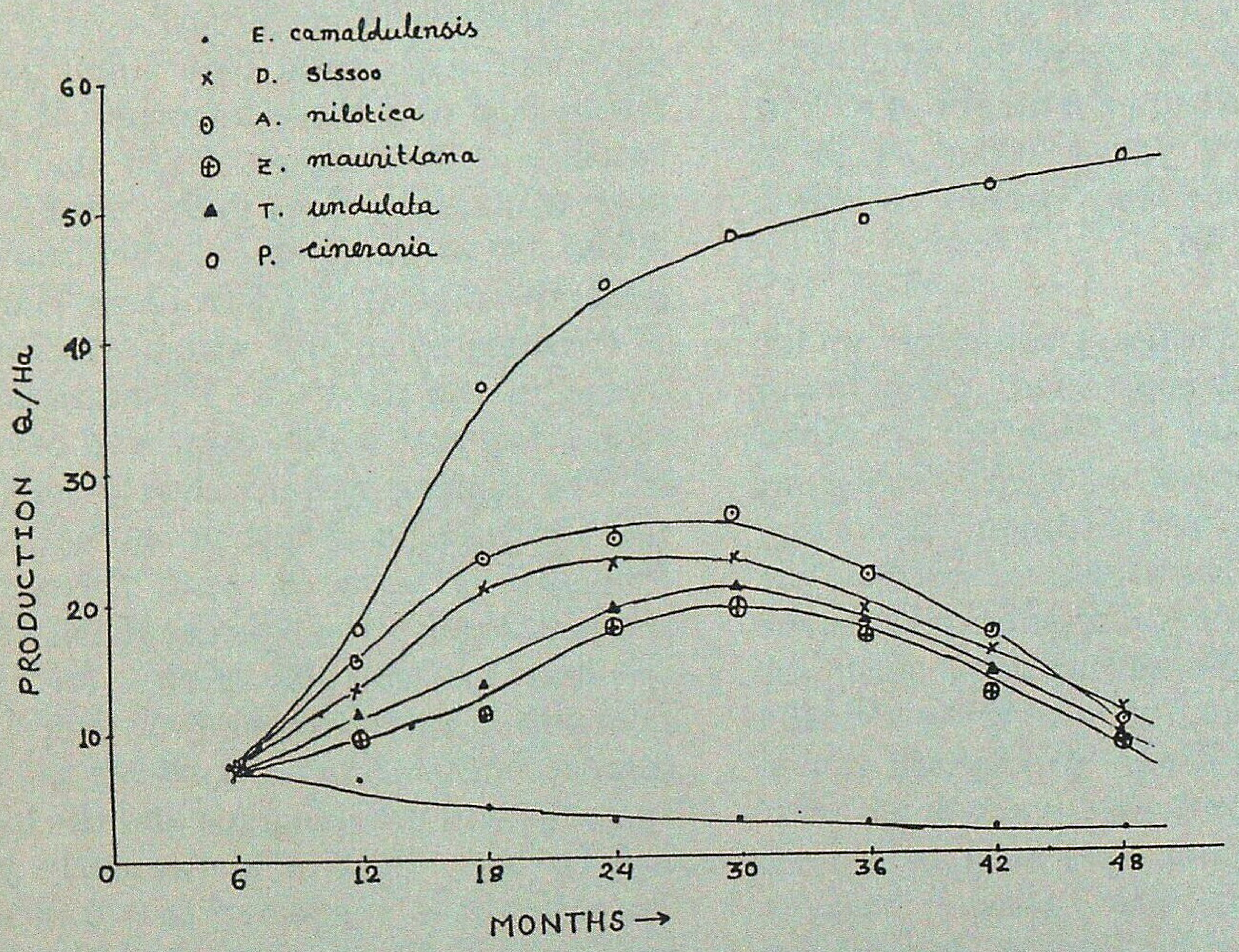
has reported that under rainfed conditions *Prosopis cineraria* and *Tecomela undulata* attained heights of 2.80 m and 3.10 m respectively in Jodhpur in 14 years. However, they attained a height of 3.87 m and 4.56 m in 4 years under irrigated conditions - hence they cannot be called slow growers at all.

So far as forage production under various species is concerned, it was found maximum in case of *Prosopis cineraria* followed by *Acacia nilotica, Dalbergia sissoo, Tecomela undulata, Ziziphus mauritiana* and *Eucalyptus camaldulensis* in this order. Under all species the first cut after six months of planting produced almost the same quantity of forage. As evident from Fig. 1, the forage production under *Eucalyptus* continuously went down with the passage of time and became almost negligible in the 4th year. In case of *Prosopis cineraria*, production kept on increasing, the rate of increase was much slower at the later stage. Under other species, production started decreasing after 30 to 36 months. The grass species which came up in the area after planting in the area were : *Cymbopogon jawarancusa, Lasiurus sindicus, Eleusine compressa, Aristida funiculata, Cenchrus biflorus* and *Eragrostis unioloides*.

The roots of one plant of *Eucalyptus* and two plants of *Prosopis cineraria* (in case of the later one having seed origin and the other having poly-bag origin), were excavated (Fig. 2). It was found that in the case of *Eucalyptus,* roots went upto 1.80 m and 80% of the root was concentrated in the top 70 cm from the surface; in fact root hairs made a mesh along the surface which discouraged any ground vegetation. On the other hand in case of nursery raised seedlings of *Prosopis cineraria* roots went beyond 3 m. However, due to coiling of roots at nursery stage a bulge on the root was found at 30 cm from the surface (the size of polythene bag); from that bulge the root trifurcated and three branches of almost equal size went down. Even the lateral roots which were three in No., after moving 0.5 to 1.0 m along the surface showed a tendency of positive geotropism. The roots of *Prosopis cineraria* which was directly sowed in the field had a prominent and strong tap root which went well beyond 3 m. The rooting pattern clearly correlates the variation in forage production under *Prosopis cineraria* and *Eucalyptus camaldulensis*. The spacing of 3 m x 2 m is too less for the plantations for forage production and the proper growth of species (except for *Eucalyptus*), however, the wider spacings will provide gaps and the barrier will be less effective in the early years. Therefore it is suggested that 3 m x 3 m spacing should be continued for initial planting and the first thinning should be done in the fourth year.

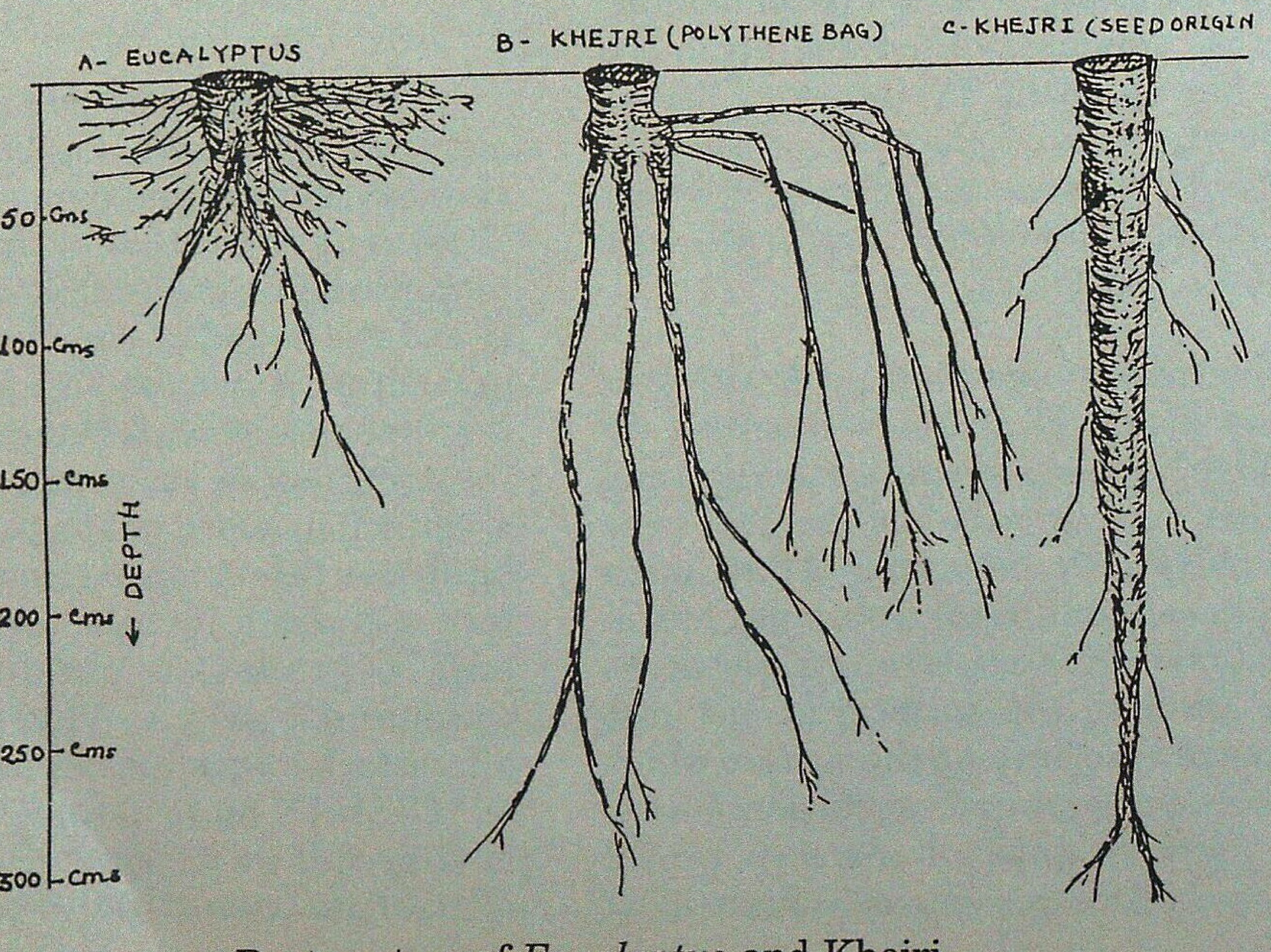
Livestock is treated as a resource base and as a safeguard for bad rain years. However, natural grasslands of Sewan grass (*Lasiurus sindicus*) are unluckily concentrated in the command area of Stage-II and are bound to vanish after irrigated agriculture starts at full swing. Thus a resource base which is being utilised during recurring famine years are on the threshold of extinction which will cause an additional burden on less extensive pastures which in turn will result into the highest degree of land degradation outside the canal command area. Therefore, from afforestation activities in command areas of I.G.N.P. more forage production is envisaged if we want to check the process of desertification effectively.

Fig. 1



Forage production under different Species.

Fig. 2



Root system of *Eucalyptus* and Khejri

SUMMARY

Based on six monthly observations on four year old canalside and block plantations in command area of Indira Gandhi Canal Project, growth rate and forage production under six species has been discussed. *Eucalyptus camaldulensis* **attained maximum height and collar girth of 12.85 m and 55 cm respectively, whereas, minimum growth was observed in case of** *Prosopis cineraria* **which attained a height of 3.87 m and collar girth of 22 cm in four years. However, forage production under** *Prosopis cineraria* **was maximum and it was minimum in association with** *Eucalyptus camaldulensis* **plantations.**

इन्दिरा गाँधी नहर परियोजना-द्वितीय चरण के खण्डों और नहर किनारे लगे रोपवनों में वृक्ष वृद्धि और चारा उत्पादन

ए०के० उपाध्याय

सारांश

इन्दिरा गाँधी नहर परियोजना के अधिकार क्षेत्र में आते चार वर्षीय नहर किनारे और खण्डों में लगे रोपवनों में किए जाते छमाही पर्यवेक्षणों के आधार पर उनकी छह वृक्ष जातियों की वृद्धि दर और चारा उत्पादन का विवेचन किया गया है । *युकेलिप्टस कैमेलड्यूलेंसिस* की अधिकतम ऊँचाई और मूलसंधि पर व्यास क्रमशः 12.85 मीटर और 55 सेमी० प्राप्त हुए । न्यूनतम ऊँचाई 3.87 मी० और मूलसंधि व्यास 22 सेमी० चार वर्षों में *प्रोसोपिस सिनेरेरिया* को प्राप्त हुए । तथापि, चारा उत्पादन *प्रोसोपिस सिनेरेरिया* में अधिकतम तथा *युकेलिप्टस कैमेलड्यूलेंसिस* रोपवनों में न्यूनतम पाया गया ।

References

Kaul, R.N. (1977). *Desertification and its Control*, I.C.A.R., New Delhi 19 p.

Upadhyaya A.K., R.G. Soni and S.P. Mathur (1991). Initial growth rate of irrigated plantations in Stage-II of I.G.N.P. *Current Agriculture* **(1-2)** : 15-21.

Upadhyaya A.K. (1991). Shelterhelt Plantations effectively check sand deposition in Indira Gandhi Canal. *Indian Forester,* **117** (7) : 511-514.

PERFORMANCE OF EXOTIC POPLARS UNDER NURSERY CONDITIONS IN HIMACHAL PRADESH

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Introduction

Himachal Pradesh, a hilly State of India in Western Himalaya, is known as an apple state of the country. There is acute shortage of wood for packing material required for transportation of its fruits and vegetables. The indigenous species of Poplar occurring naturally viz., *P. ciliata, P. euphratica, P. alba* and *P. laurifolia* have very limited scope to meet up this demand due to their slow growth and consequent low productivity. *Populus deltoides,* a fast growing exotic species, having great potential to meet this demand has successfully been grown in flat valleys in lower hills of the state as pure plantations or in agroforestry system. The clones so far used for planting in these areas are G-3, G-48 and D-121. A need was, therefore, felt to conduct trials on some more clones of *P. deltoides* with the object to find out future replacement of the present promising clones. The present investigation is a part of preliminary nursery trials conducted at Shilly Research Nursery, Solan.

Materials and Methods

Forest Research Centre, Lal Kuan (Uttar Pradesh Forest Department), Haldwani developed some *P.deltoides* clones through open pollination between male G-3 and female G-48 clones in 1982 and 1984 and nomenclatured them as L-82 and L-84. Some American clones received through Forest Research Institute, Dehra Dun were also multiplied at the same Centre. The cuttings of different clones of L-82, L-84 and American were received from Forest Research Centre, Lal-Kaun, in February, 1993. The cuttings of 22.5 cm length were prepared and planted in 1x1 m sunken beds at a spacing of 40x30 cm (40.0 cm distance between two rows and 30.0 cm distance between two cuttings in the row) in each bed at Shilly Research Nursery, Solan (H.P.). Each cutting was made air tight with the help of thumb to ensure that plant material has come in contact of mineral soil. Flooding was done after planting the cuttings. Sprouting of each clone was noted regularly till its completion. Survival and growth data (collar diameter and height) were observed on monthly intervals. In January, 1994 seven plants of each clone were dug-out for above-ground and underground biomass estimations. Control clones (G-3, G-48 and D-121) were planted for comparison of sprouting, survival percentage and growth performance, etc. under the same climatic and edaphic conditions. Location and physio-chemical characters of soil of Shilly Research Nursery, Solan are given in Table 1, while monthly climatic characters of the year, 1993 are computed in Table 2.

Table 1

Characteristics of study site and physico-chemical properties of soil.

Characteristics	Shilly Research Nursery, Solan
Longitude	77° 0'35" E
Latitude	30°45'25" N
Altitude	1350 m
Soil type	Silt-Clay-Loam
Soil depth	0.5 to 1.5 m
Soil pH	7.1
Organic Carbon (%)	2.9
Available N (ppm)	120.0
Available P (ppm)	41.0
Available K (ppm)	245.0
Available Ca (ppm)	260.0

Results and Discussions

The results of sprouting and survival percentage for each clone under study are presented in Table 3. It is evident from survival data that clones at serial number 1, 3, 4, 6, 8, 9, 10, 11, 13, 15, 16, 18, 22 and 24 are superior from survival point of view than clones at serial number 2, 5, 7, 12, 14, 17, 19, 20, 21, 23, 25, 26, 27, 28 and 29. The poorest survival was recorded for clones 74/82, 89/82 and 62/84 in ascending order. In case of control, G-3 and G-48 clones are better than D-121. Other clones which are better than D-121 in decreasing order are 64-243-1, 290/84, 34/82, 165/84, ST-72, 110120, 1467 and S7 C2. Some clones which are inferior to D-121 are 62/84, 89/82 and 74/82.

Data of growth performance and biomass of different clones are given in Table 4, which clearly indicates that G-48 and G-3 are better control clones than D-121. In succeeding paragraphs performance of different exotic clones are discussed in relation to G-3, G-48 and D-121, which are generally used by farmers in lower areas of Himachal Pradesh. All the clones under study have performed better than G-3, G-48 and D-121 in respect of collar diameter and height except 188/84, 1467 and 74/82 clones.

Table 2

Monthly climatic characters of the study site for the year, 1993

Months	Temperature °C		Rainfall (mm)	Humidity (%)	Number of Rainy Days
	Mean Maximum	Mean Minimum			
January	10.11	4.32	62.0	58	7
February	18.73	5.78	-	52	-
March	18.20	5.80	75.3	55	9
April	26.56	5.60	12.6	53	2
May	34.42	12.03	25.2	51	5
June	34.60	14.48	237.1	78	18
July	28.85	20.15	391.3	80	22
August	30.80	16.34	139.0	75	19
September	27.42	13.73	125.5	70	13
October	28.95	9.08	-	55	-
November	24.96	5.38	8.2	53	1
December	20.48	3.52	-	50	-

Table 3

Sprouting and Survival percentage of different exotic Poplar clones

Sl. No.	Clones	No. of Cuttings planted	No. of Cuttings sprouted	Sprouting percentage	Survival percentage
	L-82				
1.	52/82	10	10	100.00	100.00
2.	74/82	10	7	70.00	50.00
3.	29/82	12	12	100.00	100.00
4.	12/82	11	11	100.00	100.00
5.	34/82	12	12	100.00	83.33
6.	49/82	10	10	100.00	100.00
7.	89/82	11	8	72.77	63.66
8.	30/82	10	10	100.00	100.00
9.	13/82	10	10	100.00	100.00
	L-84				
10.	247/84	8	8	100.00	100.00
11.	75/84	11	11	100.00	100.00
12.	51/84	10	9	90.00	90.00
13.	71/84	9	9	100.00	100.00
14.	62/84	11	10	90.99	63.66
15.	200/84	10	10	100.00	100.00
16.	293/84	10	10	100.00	100.00
17.	290/84	9	9	100.00	88.88
18.	181/84	12	12	100.00	100.00
19.	188/84	10	9	90.00	80.00
20.	165/84	12	11	91.66	83.33
	Americans				
21.	113324	10	9	90.00	90.00
22.	110702	7	7	100.00	100.00
23.	ST-72	12	11	91.66	83.33
24.	S7 C1	10	10	100.00	100.00
25.	110120	11	9	81.88	81.88
26.	111828	10	10	100.00	90.00
27.	1467	11	10	90.99	81.88
28.	64-243-1	11	10	90.99	90.99
29.	S7 C2	10	9	90.00	70.00
	Control				
30.	G-3	12	10	83.33	100.00
31.	G-48	12	10	83.33	100.00
32.	D-121	12	9	75.00	66.60

Table 4

Growth performance and biomass studies of different exotic Poplar clones

Clones	Average collar diameter (cm)	Average height (cm)	Biomass/plant (g)		Total biomass (g)	Above-ground/ underground/ Ratio
			Above-ground	Under-ground		
1	2	3	4	5	6	7
L-82						
52/82	1.07 ± 0.16	168.70 ± 35.27	54.75 ± 11.49	25.03 ± 9.34	79.78	2.1
74/82	0.64 ± 0.25	58.14 ± 31.21	14.65 ± 9.33	9.74 ± 5.01	24.39	1.5
29/82	1.03 ± 0.17	133.50 ± 41.06	64.00 ± 5.47	38.09 ± 14.78	102.09	1.6
12/82	1.14 ± 0.16	171.45 ± 40.13	49.62 ± 12.12	23.25 ± 14.0	72.87	2.1
34/82	1.03 ± 0.13	136.33 ± 40.07	57.20 ± 11.88	28.71 ± 14.54	85.91	1.9
49/82	0.98 ± 0.26	139.80 ± 47.24	42.76 ± 14.04	19.54 ± 11.72	62.30	2.1
89/82	1.03 ± 0.15	114.01 ± 49.49	40.50 ± 23.23	18.94 ± 13.19	59.44	2.1
30/82	1.20 ± 0.12	172.50 ± 32.29	56.53 ± 15.36	25.12 ± 17.71	81.65	2.2
13/82	0.90 ± 0.30	126.90 ± 47.16	30.46 ± 7.35	11.92 ± 4.85	42.38	2.5
L-84						
247/84	1.47 ± 0.25	211.12 ± 45.16	91.79 ± 9.40	36.46 ± 14.72	128.25	2.5
75/84	1.53 ± 0.20	205.27 ± 32.51	90.00 ± 13.31	35.09 ± 16.16	125.09	2.5
51/84	1.42 ± 0.35	182.22 ± 52.89	70.22 ± 15.09	28.54 ± 19.14	98.76	2.4
71/84	1.12 ± 0.29	159.00 ± 48.28	54.00 ± 14.75	22.60 ± 13.42	76.60	2.3
62/84	0.68 ± 0.30	116.60 ± 55.78	50.52 ± 13.10	24.16 ± 12.24	74.68	2.0
200/84	1.41 ± 0.16	204.80 ± 54.40	71.19 ± 7.23	31.56 ± 19.72	102.75	2.2
293/84	0.93 ± 0.16	125.20 ± 29.72	30.73 ± 14.85	13.47 ± 5.10	44.20	2.2
290/84	1.06 ± 0.83	135.87 ± 19.55	37.28 ± 3.97	16.84 ± 9.52	54.12	2.2

Contd...

1	2	3	4	5	6	7
181/84	1.95 ± 0.22	153.00 ± 45.95	52.48 ± 10.17	23.46 ± 12.54	75.94	2.2
188/84	0.84 ± 0.23	100.37 ± 28.44	14.18 ± 3.97	6.72 ± 4.80	20.90	2.1
165/84	1.13 ± 0.15	157.10 ± 27.96	42.68 ± 19.91	19.73 ± 11.52	62.41	2.1
Americans						
113324	0.98 ± 0.13	116.20 ± 36.92	33.39 ± 13.79	15.47 ± 6.20	48.86	2.1
110702	1.35 ± 0.13	191.28 ± 17.62	83.30 ± 22.80	39.46 ± 16.52	122.76	2.1
ST-72	1.10 ± 0.25	133.55 ± 58.67	63.74 ± 19.79	26.27 ± 12.92	89.51	2.4
S7 C1	1.36 ± 0.27	197.90 ± 45.31	79.56 ± 32.75	29.47 ± 11.43	109.03	2.6
110120	1.23 ± 0.24	130.33 ± 49.44	50.82 ± 16.83	22.45 ± 14.82	73.27	2.2
111828	1.14 ± 0.22	135.75 ± 42.63	31.82 ± 6.52	13.14 ± 9.52	44.96	2.4
1467	0.71 ± 0.23	85.44 ± 24.61	11.32 ± 3.02	4.42 ± 3.12	15.74	2.5
64-243-1	1.17 ± 0.23	170.60 ± 33.63	56.47 ± 7.70	22.54 ± 13.71	79.01	2.5
S7 C2	1.25 ± 0.13	190.14 ± 17.06	30.46 ± 7.35	12.92 ± 8.34	43.38	2.3
G-3	0.90 ± 0.20	105.0 ± 33.24	52.57 ± 11.64	19.76 ± 7.50	72.33	2.6
G-48	0.98 ± 0.31	112.70 ± 43.32	60.97 ± 19.12	23.57 ± 6.19	84.54	2.5
D-121	0.63 ± 0.25	80.50 ± 37.17	18.79 ± 7.63	9.12 ± 4.20	27.91	2.0

± is the standard deviation of mean.

The poorest performance was noted of 74/82 clone which is even inferior to D-121 clone in respect of both the characters. The best performance was recorded for clones 247/84, 75/84, 200/84, S7 C1, 110702, S7 C2 51/84, 30/82, 12/82 64-243-1 and 52/82 in decreasing order. Other clones also performed better than controls either in height or diameter. G-48 is superior among the controls followed by G-3 and D-121.

From biomass point of view G-48 is superior than G-3 and D-121. Other clones which produced more organic matter than G-48 are 247/84, 75/84, 110702, S7 C1, 200/84, 29/82, 51/84 and 34/82 in descending order. Rest of the clones produced less organic matter than G-48 (Table 4). In comparison of clone G-3 which produced less biomass than G-48, other superior clones are 30/82, 52/82, 64/243-1, 71/84, 181/84, 62/84 and 110120. However, clones 74/82, 188/84 and 1467 are inferior than D-121. Other clones which are better than D-121 in

descending order are 12/82, 165/84, 49/82, 89/82, 290/84, 113324, 111828, 293/84, S7 C2 and 13/82, respectively. Above-ground and underground biomass ratio indicates that all the cones under study produce more above-ground biomass than underground and varies from 1.5 to 2.6. Similar results were observed earlier by Mathur *et al.*, (1982) in *Populus ciliata.* Collar diameter and height have direct bearing with organic matter production (Singh, 1976) and the same trend was observed in the present study. From the results of survival, growth performance and organic matter production, it is evident that *Populus deltoides* clones 247/84, 75/84, 29/82, 200/84 and 51/84 are very promising while clones 110702, S7 C1, ST-72 and 64-243-1 are considered to be promising among American clones. These clones are being further tested in different locations in Himachal Pradesh by Conifers Research Centre, Shimla. During the present trial no fungal infection was noticed on any clone.

Acknowledgements

Authors are thankful to the authorities of Forest Research Centre, Lal Kaun (Haldwani). Forest Department for providing the planting material for present study. We are also thankful to the staff of Shilly Research Nursery, Solan for rendering the help in conducting the present trial.

SUMMARY

In search of promising clones suited to lower areas of Himachal Pradesh, a nursery trial of twenty nine exotic clones received from Forest Research Centre, Lal Kuan (Uttar Pradesh Forest Department) was conducted. *Populus deltoides* clones 247/84, 75/84, 29/82, 200/84 and 51/84 and American clones 110702, S7C1, ST-72 and 64-243-1 were proved to be the best suited for this tract. These clones are being further tested in different nurseries, situated in different agro-climatic conditions, of Conifers Research Centre, Shimla for Large scale plantation programme.

हिमाचल प्रदेश में रोपणी दशाओं में विदेशी पोपलरों की क्रियाशीलता

आर०पी० सिंह व डी०वी० नेगी

सारांश

हिमाचल प्रदेश के सिंचाई क्षेत्रों के लिए उपयुक्त उत्साहप्रद कृन्तकों की खोज के लिए वन अनुसंधान केन्द्र, लाल कुआँ (उत्तर प्रदेश वन विभाग) से प्राप्त हुए 29 विदेशी कृन्तकों पर एक रोपणी परीक्षण किया गया । इस क्षेत्र खण्ड के लिए *पापुलस डेल्टायडिस* कृन्तक 247/84, 75/84, 29/82, 200/84 और 51/84 अमेरिकी कृन्तक 110702, एस7सी1/एसटी-72 और 64-243-1 सबसे ज्यादा उपयुक्त रहे । इन कृन्तकों पर विभिन्न कृषि जलवायु दशाओं में उपयुक्ता मालूम करने के लिए शंकुधर अनुसंधान केन्द्र, शिमला में बड़े परिमाण पर रोपवन लगाने के कार्यक्रम के अन्तर्गत विभिन्न रोपणियों में आगे और परीक्षण कराए जा रहे हैं ।

References

Mathur, H.N., R.P. Singh and K.C. Sharma (1982). *Populus ciliata* - a promising tree species for soil conservation in hilly areas. *Indian Forester,* **108** (9) : 599-604.

Singh, R.P. (1976). Studies on annual net production, mineral standing state and energy accumulation pattern of *Eucalyptus tereticornis* Smith in Western Uttar Pradesh. *Ph. D. Thesis,* Meerut University, Meerut.

BIOMASS PRODUCTION AND ROOTING BEHAVIOUR OF *EUCALYPTUS TERETICORNIS* SM. ON DEEP SOILS AND RIVERBED BOULDERY LANDS OF DOON VALLEY, INDIA

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Introduction

Eucalyptus species was introduced in India around 1790 (Anon, 1990). The species has wide adaptability under varied agroclimatic situation, therefore, it was been planted to replace low value and natural scrub forests, for afforesting arid and semi-arid areas and other wastelands. *Eucalyptus* has been found very successful for roadside, canal banks, field bunds and energy plantations in village/community lands under social/agroforestry programmes. The species is often planted in degraded lands, which are having poor nutrient status and low water holding capacity. In such situations the species has to develop an extensive network of roots to tap the meager amount of nutrient and soil moisture. However, reports on roots system of *Eucalyptus* are scanty (Dabral *et al.*, 1987; Haigh, 1966; Mathur and Raj Francis, 1990; Zimmer and Grose, 1958). Moreover, the information available on root distribution is mostly concentrated on the total root mass, though it is the finest part of the root system (i.e. fine root) which is most dynamic and more actively involved in water and nutrient uptake (Dhyani *et al.*, 1990). Knowledge of total root distribution of tree species is therefore very crucial in determining its suitability for planting.

The study was initiated to compare biomass production by *Eucalyptus tereticornis* Sm. planted on two sites with apparently large differences in productivity potential, one high productive deep soil, the other a relatively poor riverbed bouldery land. Of particular interest in this study was determining the relative proportion of biomass production occurring above and below the soil surface at these two sites. Our hypothesis was that a greater energy expenditure in the form of below ground dry matter production, would be required by the plants growing on riverbed bouldery lands than by those growing in deep soils. Therefore, more emphasis was placed on examining below ground production.

Materials and Methods

Site description : The location and site characteristics of the study area are discussed in an earlier study (Dhyani *et al.*, 1990). The site in riverbed bouldery land termed 'Site A' belongs to Bainkhala soil series, is derived from very gravelly recent alluvium (Bhardwaj and Singh, 1981). It was found that only the first 10-25 cm of the profile has good textured soil followed by boulders and gravels of different shape and size at lower depths (Table1).

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Table 1

Mechanical and Chemical analysis of soil profile at riverbed bouldery lands (Site A) of Doon Valley, India

Depth (cm)	Mechanical composition (%)								
	Coarse sand	Fine sand	Silt	Clay	Total N (%)	Av. P_2O_5 (kg ha^{-1})	Av. K_2O (kg ha^{-1})	Org. C (%)	pH
0-25	12.4	64.6	11.5	11.5	0.06	12.0	134.4	0.64	6.0
25-50	78.2	14.8	1.0	6.0	0.02	4.6	43.2	0.15	6.5
50-75	57.5	38.5	0.5	3.5	0.01	2.1	33.6	0.06	6.5
75-100	75.8	19.2	0.5	4.5	0.01	2.4	36.0	0.11	6.8
100-125	81.0	13.0	1.0	5.0	0.01	3.0	38.4	0.12	6.8

The boulderiness of the riverbed land representing various diameter class of the boulders, gravels and soil indicates that the upper one meter soil profile is consisted of about 74% of gravels and boulders and 26% of the soil particles of 0.20 cm diameter (Singh *et al.*, 1985). Mechanical analyses (Table 1) has shown that coarse fraction increased from 12.4% in top 25 cm profile to 81% at 100-125 cm depth. There was corresponding decrease in the fine fraction of clay and slit. The soil : stone ratio (volume) which was 70 : 30 in top soil profile, decreased to 15:85 in 100-125 cm layer. The water holding capacity is low and the infiltration rates are high (21.3 mm hr^{-1}). On the whole the land is very gravelly/bouldery and poor in nutrient contents.

The site in deep soils termed 'Site B' belongs to the Dhoolkot soil series, derived from old and deep alluvium under forest cover (Bhardwaj and Singh, 1981). The soils (Udic-hapdust-alf) of the experimental area are noncalcerous with medium (silty loam) surface texture and heavy sub-soil (silty clay) having medium to high quantities of nutrients (Singh *et al.*, 1985).

Total root exposure : In degraded bouldery riverbed lands (Site A), in an experiments where seedlings were planted in 50 cm, 75 cm and 100 cm deep with 26 cm diameter holes in a randomized block design at 2 x 2 m spacing, for root studies, 32 representative plants from 1984 (A-III), plantation having a mean tree height and a mean tree diameter close to the average were selected for exposure. At the sametime four representative plants each from 1982 (A-I) and 1983 (A-II) plantations were also selected for exposure in order to find out differences in root extent. Similarly, in deep soils (Sit B) seedlings raised in 1985 in 45 cm^3 pits in randomized block design at 3 x 3 m (B-I) and 1.5 m x 1.5 m (B-II) spacing were selected for root studies. In all 24 representative plants were exposed from this site.

There were, therefore, 30, 42 and 54 months old plants from Site A with 2500 stand density and 30 months old plants at Site B with 1111 and 4444 stem density (Table 2). Plants were maintained by regular weeding and hoeing. Periodic measurements for survival, height and diameter increment

Table 2

Stand characteristics of Eucalyptus tereticornis plots studied

Site	Age (months)	Stand density (stem ha^{-1})	Growth			Secondary roots (No. plant^{-1})	Maximum lateral spread (m)
			Mean dbh (cm)	Mean height (m)	Root depth (m plant^{-1})		
Riverbed lands						Range	
A-I	54	2500	8.7	8.60	2.15*	24-44	4.65
A-II	42	2500	8.4	8.60	1.85*	14-24	5.10
A-III	30	2500	6.5	5.30	1.21*	13.21	1.89
Deep soils							
B-I	30	1111	5.8	4.60	4.15	5-8	1.25
B-II	30	4444	5.4	4.10	3.15	8-12	1.08
CV (%)			19.38	27.67	41.39	54.95	61.78

*Root coiling observed

were recorded for all plants. Two measurements of diameter at right angles to each other were taken and an average value calculated.

The roots were excavated by the Skeleton method (dry excavation), digging along the course followed by the roots in soil mass. The root crowns were anchored to retain their normal positions throughout the process of digging the soil and exposing the roots. Measurements of the root system was done although the period of digging. A great deal of hand digging had to be done to extract finer roots.

Below-ground sampling : fine root biomass determination : During the first week of December, the biomass of fine root (<5 mm in dia.) of *Eucalyptus* on deep soils was determined. At this time of the year, the development of fine roots could be expected to be quite good, though not to be at its highest. Root biomass was determined by sorting fine roots from soil cores (Dhyani *et al.*, 1990).

However, as it was difficult to take soil cores in the riverbed bouldery lands due to presence of stones and gravels, therefore, samples of fine roots were taken from successive depths at the time of total excavation. In this case all the roots less than 5 mm in diameter were termed fine roots. In the laboratory, roots were separated from other organic matter through sieving and were dried for dry mass determination (70°C, 24 hr.).

Results and Discussion

(a) *Root characteristics* : The rooting pattern

of plants is inherently a genetic character of a species but environmental conditions (soil, air and moisture) considerably modify it. Consequently roots adapt themselves to develop system well adjusted to the prevailing environment. The characteristics viz. depth, number, lateral spread, diameter, weight and percentage of roots in soil indicate its habit under particular set of conditions.

Depth of roots : The depth of the root penetration indicates the zone of intensive root activities in the soil. In deep soils, a *Eucalyptus* seedling quickly develops a long stout tap root which reaches to a length of 1.20 m by the end of first reason, 2.85 m in 16 months and in 30 months it penetrated to a depth of 4.15 m (Dhyani *et al.*, 1990). However, bulk of roots (mainly fine roots) are to be found in upper soil profile. The property of accumulating maximum fine roots in upper soil profile provide the plant an easy access to the moisture and nutrients on topsoil, while the primary root going to deeper depth helps in extracting moisture from there (Dhyani *et al.*, 1990). In bouldery riverbed lands, on the other hand it was observed that the tap root penetrated to a depth of 1.2 m, 1.85 m and 2.15 m after 30, 42 and 54 months of planting, respectively (Table 2). As indicated in site description, first 10-25 cm soil profile has good textured soil, so a large number of roots concentrated at this depth to tap available nutrients. The reason for the shallow depth of tap root here as compare to deep soils may be the presence of impediments in the form of gravel, boulders and other hard formations, which needed more energy and hence restrict free entry of roots; and high water table, especially during the month of July-August, the water table is at the depth of 1.8 m, to 2.0 m only. On the other hand, long tap root development in deep soils may be due to ease in its penetration because of congenial environment.

Number of roots : The amount of water and mineral nutrients available to a plant is determined by the amount of branching and the distance to which roots extend horizontally and vertically. Kramer (1969) suggests that the horizontal and vertical extent of root systems and the degree of its branching are important for the success of plant. In bouldery lands large number of strong lateral roots, along with the tap root were observed. The number of secondary roots produced in 30, 42 and 54 months old plants in bouldery lands were more (13-44), while in the deep soils the average number of roots remained restricted to 5-12 only (Table 2).

Lateral spread : Significant differences in lateral root spread (cv. 61.78%) was observed at the two sites. In the riverbed bouldery lands, right from the beginning *Eucalyptus* formed large number of strong lateral roots, most of which moved horizontally as much as 4.65 m to 5.10 m within 30-90 cm soil profile (Table 2). This extensive lateral formation in bouldery lands could be attributed to its need to provide anchorage to plants and meet moisture requirement. In deep soils maximum lateral spread remained confined to 1.35 m only. These roots originated just below the collar, were evenly distributed and thin in diameter.

Percentage of roots in soil : In bouldery lands roots were more in numbers, have extensive network and larger diameter. Consequently, there was higher percentage of roots per unit volume of soil. However, in deep soils the percentage was quite low. The distribution of trees in a stand also influence the path of root spread. The observation indicated that roots of this

species avoided the path where other roots existed and confined its spread in vacant spaces only. No inter-twinning and inter-mingling of roots was noticed.

Fine root biomass : At both sites a more or less pronounced decline in fine root biomass with increasing soil depth was observed. Fine root production on the riverbed bouldery lands was approximately three times that on the deep soils (Table 4). These figures are likely to be underestimate since dead roots are not accounted for. Moreover, without a detailed study of seasonal production and mortality of roots the reliability of a single (static) determination of fine root biomass depends mainly on the time (date) and intensity of sampling (Keyes and Grier, 1981).

(b) *Root coiling* : In most of the cases tap root formation takes place in juvenile stage (inherent character), but with increasing age it starts branching depending upon then prevalent environment (phenotypic response). Soil properties, especially bulk density influences root growth significantly and a linear decline in rooting with increase in bulk density has been reported for sunflower plant, Douglas-fir, Sal and *Eucalyptus,* Soybeans and Sudan grass (Dabral, *et al.*, 1984 and 1987; and Zimmerman and Kardon, 1961, all cited by Dabral *et al.*, 1987). However, there is very little information available about the rooting behaviour in bouldery or hard pan sites. In present study, due to negligible soil impediments in top few centimeters of soil profile roots grew normally. But beyond it the tap root developed contortions/coiling in the bouldery lands (Fig. 1), indicating the tremendous effort the root had to exert in pushing its way through the impediments (gravel, boulders, stones and other hard formation) in the soil mass at different depths.

Efforts were made to compare ramification of roots and establish relationship between vertical root length and total root length to be known as "Coiling Factor".

$$\text{Coiling factor (CF)} = \frac{1_1}{1}$$

where 1_1 = length of coiled root (cm)
1 = actual extended length (cm) of the same root measured after elongation.

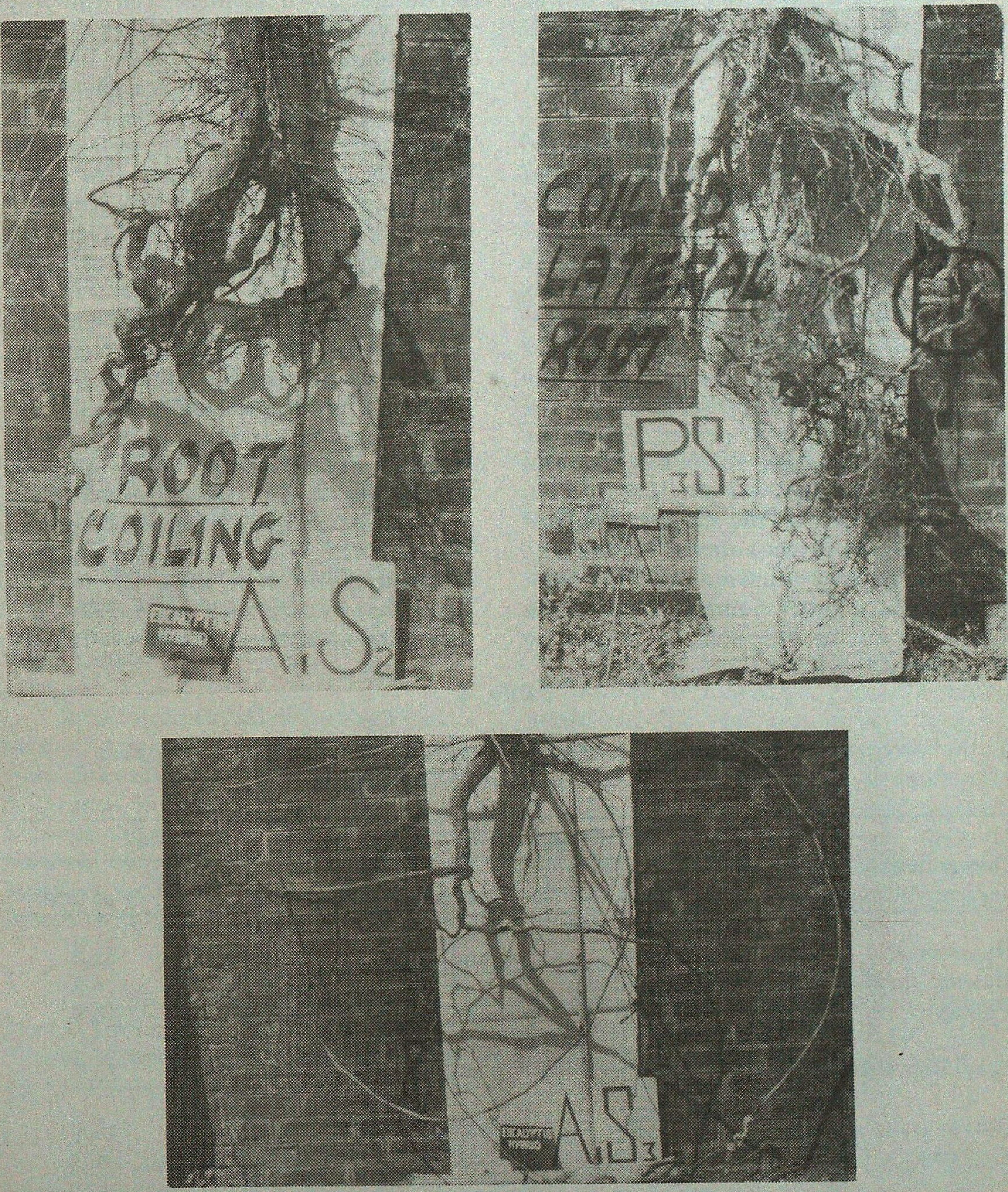
Coiling factors for roots (Table 3) indicated that shallow soil working depth (50 cm and 75 cm) cause more coiling/twisting of roots than deeper (100 cm) ones. In some cases, coiling was observed even in the lateral roots (Fig. 1B). A high negative correlation between coiling factor and growth; and biomass production was observed (Figs. 2 and 3), which indicates that coiling of roots directly influences growth and biomass production. Age has profound influence on root coiling, number of secondary roots and maximum lateral spread (Table 2). Also it is expected that fast growing species like *Eucalyptus* will have more coiling of roots in degraded or more compact soils in comparison to a slow growing species. However, we could not test

Table 3

Effect of depth of soil working on root ramification of Eucalyptus tereticornis in degraded riverbed lands

Depth of soil working (cm)	Coiling factor	
	Range	Mean
50	0.48-0.54	0.52
75	0.53-0.60	0.57
100	0.61-0.68	0.65
Standard deviation		0.056

Fig. 1 A-C



Roots of *Eucalyptus tereticornis* from degraded bouldery riverbed lands showing coiling (1A); coiled lateral root (1B); and length of lateral roots (1C).

it at this stage. From the study it can be inferred that in bouldery riverbed lands deeper soil working will help in quick establishment of plants.

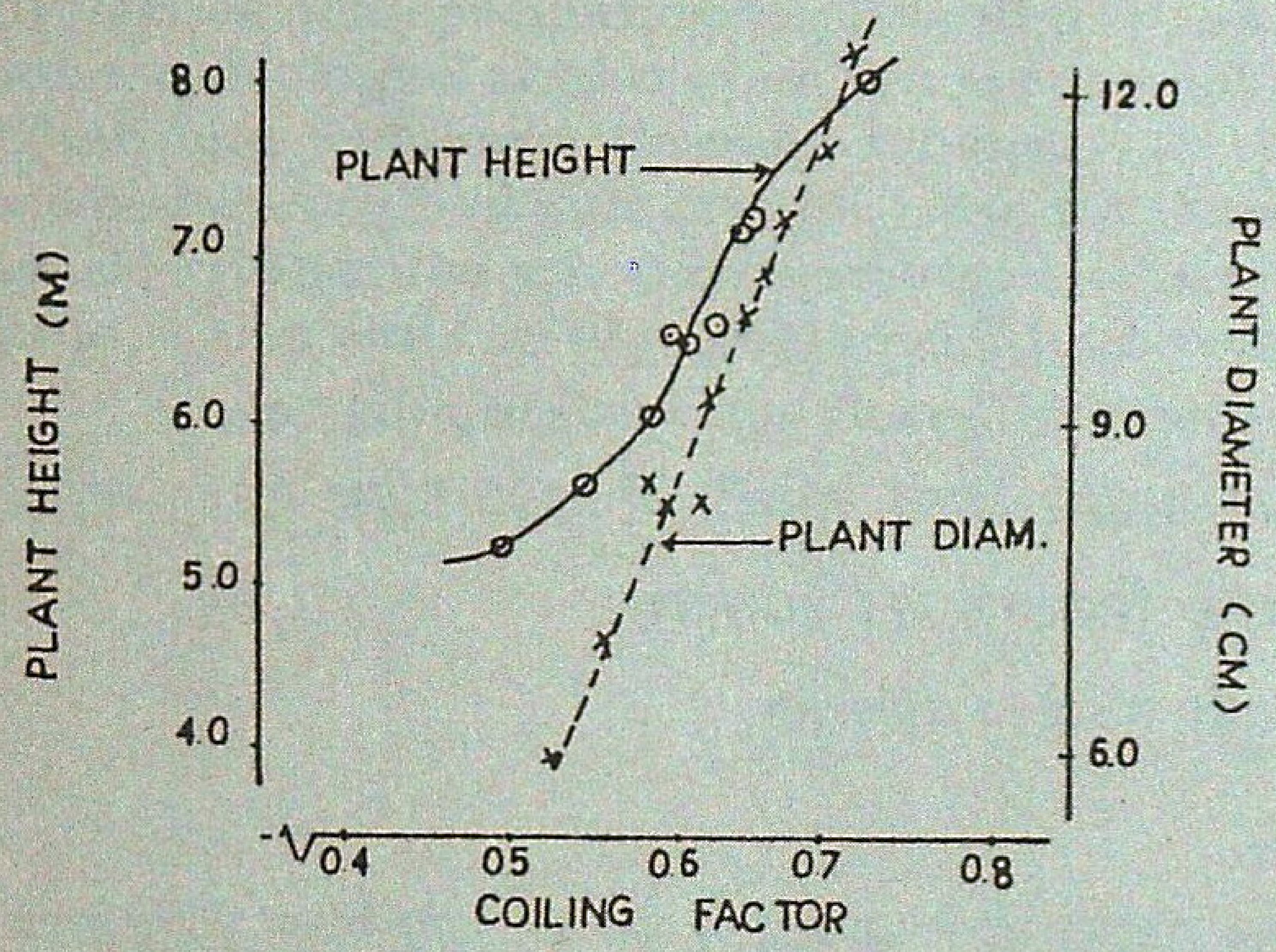
(c) *Total stand biomass* : Above ground biomass of *Eucalyptus* on the riverbed bouldery lands was 20.83 t ha^{-1} (65.4% of total biomass); whereas it was 23.30 t ha^{-1} (75.7% of total biomass) on deep soils. The major components contributing to this difference was stemwood (Table 4). However, there was no marked difference in total biomass production on the two sites, the difference being only 1.06 t ha^{-1} . On the riverbed bouldery lands, about 35% of the total biomass was in below ground components, while it was only 24% on deep soil. It indicates that the stand on riverbed bouldery lands invested a greater share of its dry matter production on fine root production, a larger number of which are likely to die in due course, hence, no accumulation of biomass, consequently poor above ground growth, which leads to low productivity. Thus, it can be inferred that in such lands, which are considered low productive site (wastelands) above ground growth was reduced in favour of investing more energy below ground to develop and maintain uptake structure i.e. a root system with high surface area of absorbing roots which are well distributed throughout the soil profile and travel to long distance. Moisture and nutrients are the major constraints for better growth. On these sites, hence this shift in production allocation from above to below ground may be an essential mechanism to avoid or alleviate stress (Keyes and Grier, 1981). In case of deep soils, the stands transfer most of its production into above ground biomass increment, which indicates higher productivity on these sites. The reasons being that in deep soils the nutrients are well distributed throughout the soil profile

Table 4

Above and below ground biomass of Eucalyptus tereticornis on deep soils and riverbed bouldery lands of Doon Valley, India

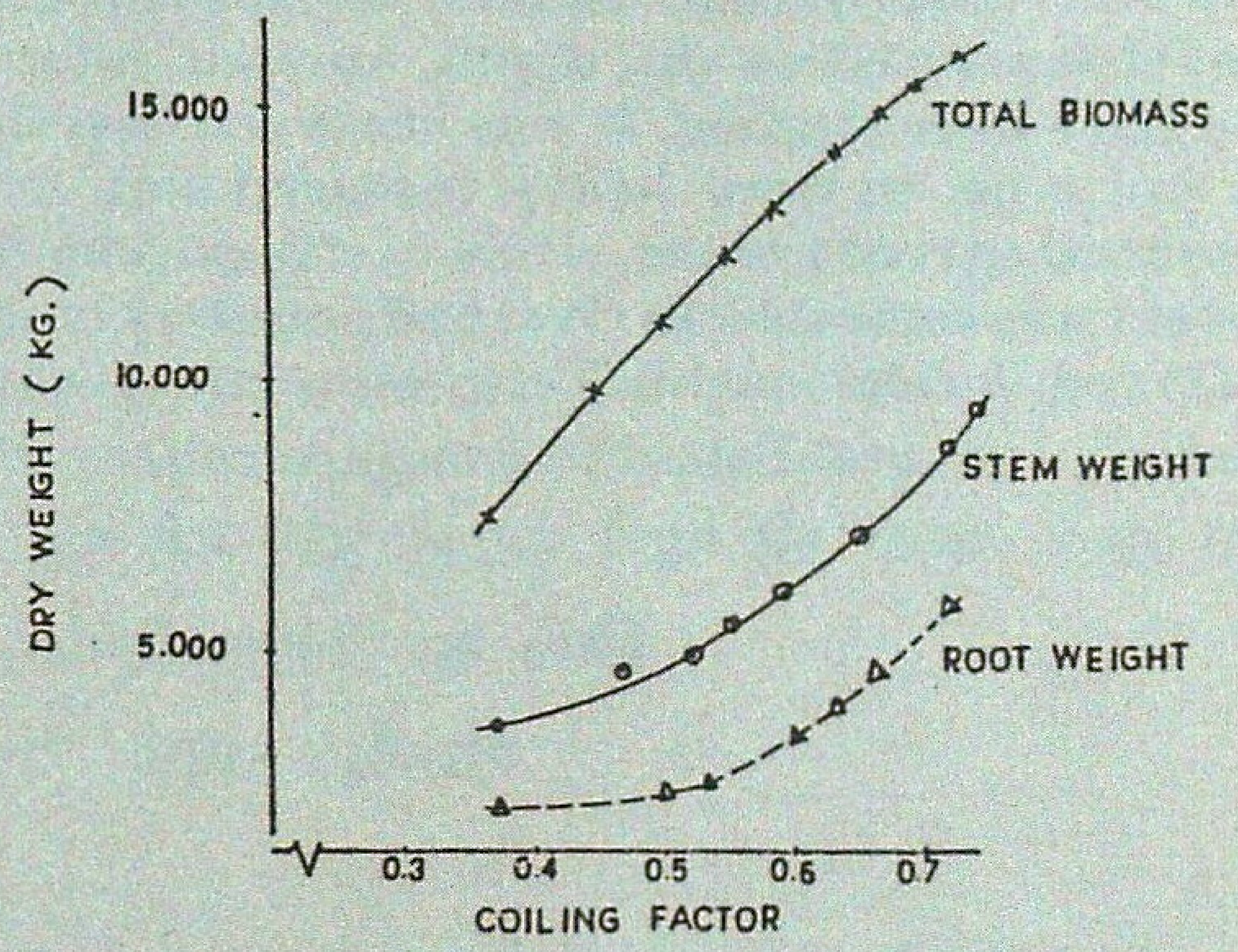
Components	Riverbed lands		Deep soil	
	t ha^{-1}	% of total	t ha^{-1}	% of total
Stem wood	14.39	45.2	16.08	52.2
Branch wood (< 5 cm)	1.96	6.1	2.12	6.9
Foliage	4.48	14.1	5.10	16.6
Total above ground	20.83	65.4	23.30	75.7
Coarse root (> 5 mm)	2.63	18.2	4.78	15.5
Fine root (< 5 mm)	8.40	26.4	2.73	8.8
Total below ground	11.04	34.6	7.51	24.3
Total biomass	31.87	100.0	30.81	100.00

Fig. 2



Coiling factor v/s
Plant height and diameter

Fig. 3



Coiling factor v/s Plant weight, stem weight
and total biomass (oven dry wt.)

hence, it does not require an elaborate network of roots. However, it is essential to have periodic examination of fine root dynamics to find out the below ground contribution to total production which may be grossly underestimated.

Conclusion

In this study the above ground biomass production was found to be greater on deep soils. However, overall there was very small difference in total biomass production between the two sites. The below ground biomass was markedly higher in riverbed bouldery lands, which indicates that the above ground growth was reduced in favour of expanding more energy below ground to develop and maintain more roots (uptake structures and for anchorage) which may be an essential mechanism to survive in the harsh environment (water and nutrient deficiencies, impediments).

Thus, the study clearly indicates that physical environment plays greater role in modifying the root system of a species. Further, it was evident that nutrient and moisture status at different soil depths are not the same and maintenance of a root system having a high surface area of absorbing roots well distributed throughout the soil profile provides greater advantage in degraded lands.

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SUMMARY

Above and below ground biomass production was estimated for *Eucalyptus tereticornis* Sm. stands growing on deep textured soils and riverbed bouldery lands of Doon Valley. Above ground biomass production was 23.30 t ha^{-1} on the deep soils and 20.83 t ha^{-1} on the riverbed lands, while below ground production on these two sites was 7.51 t ha^{-1} and 11.04 t ha^{-1} respectively. On the deep soils, 8.7% of total stand dry matter production was in fine roots, in contrast to over 26% on the riverbed lands.

However, the difference in total biomass production between the two sites was small (1.06 t ha^{-1}). The root characteristics viz., depth, number, lateral spread, weight and percentage roots in soils at the two sites were studied. It was observed that the development of the main root is largely dependent on soil type. In deep heavy textured soil, *Eucalyptus* developed a sparsely branched and deeply penetrating root system, while in riverbed bouldery lands a more compact intensively branched root system was recorded. In riverbed bouldery lands due to presence of impediments, coiling of roots was observed. A relationship between vertical root length and total root length to be known as "Coiling Factor" was established to compare coiling of roots under different soil working depths.

दून घाटी, भारत की गहरी मृदाओं और नदी पाट की गोल पत्थरों वाली भूमियों में *युकेलिप्टस टेरेटिकार्निस* स्मि० का जैवपुंज उत्पादन और जड़ें निकलने का व्यवहार

एस०के० ध्यानी, डी०एन० पुरी व पी० नारायण

सारांश

दून घाटी की गहरे वयन वाली मृदाओं तथा नदी पाट की गोल पत्थरों वाली भूमियों में उग रहे *युकेलिप्टस टेरेटिकार्निस* स्मि० के वृक्षों के भूमि से ऊपर और उसके नीचे के जैवपुंज उत्पादन का आकलन किया गया है । भूमि से ऊपर जैवपुंज 23.30 टन/हेक्टेयर गहरी मृदाओं में तथा 20.83 टन/हेक्टेयर नदी पाट की भूमियों में पाया गया जबकि भूमि से नीचे जैवपुंज उत्पादन इन दोनों स्थलों पर क्रमशः 7.51 टन/हेक्टेयर और 11.04 टन/ हेक्टेयर रहा । गहरी मृदाओं में खड़े वृक्षों के कुल शुष्क पदार्थ उत्पादन का 8.7% बारीक जड़ों में था जबकि नदी पाट की भूमियों में इसका प्रतिशत 26% से भी ज्यादा था । तथापि इन दोनों स्थलों में कुल जैवपुंज उत्पादन का अन्तर कम (1.06 टन/हेक्टेयर) ही था । जड़ों की विशिष्टताओं अर्थात्, गहराई, संख्या, पार्श्विक फैलाव, भार और मृदा में जड़ों का प्रतिशत का अध्ययन भी दोनों स्थलों के लिए किया गया । देखने में यह आया कि मुख्य जड़ों का विकास बहुत करके मृदा प्ररूप पर आश्रित है । गहरी भारी वयन वाली मृदाओं में युकेलिप्टस में कम शाखाओं वाली और अधिक गहरे जाती जड़ों वाली प्रणाली का विकास होता है जबकि नदी पाट की गोल पत्थरों वाली भूमियों में उससे कहीं अधिक निविड़ सघन शाखाओं वाली जड़ प्रणाली विकसित होती हुई देखी गई । बाधाओं के कारण नदी पाट की पथरीली भूमियों में जड़ों का कुण्डलन होता पाया गया । जड़ों की उदग्र लम्बाई और जड़ों की कुल लम्बाई में भी एक संबन्ध स्थापित किया गया है ।

References

Anon. (1990). *Plants for reclamation of wastelands* (Eds. T.C.S. Sastry and K.Y. Kavathakar) CSIR, New Delhi. pp. 683.

Bhardwaj, S.P. and P.N. Singh (1981). Soil and land capability and land use characteristics of Soil Conservation Research Farm, CSWCRTI, Dehra Dun, *Bulletin No. T-14/17.*

Dabral, B.G., S.P. Pant and S.C. Pharasi (1987). Root habits of *Eucalyptus* - some observations. *Indian Forester,* **113**(1): 11-32.

Dhyani, S.K., P. Narain and R.K. Singh (1990). Studies on roots distribution of five multipurpose tree species in Doon Valley, India. *Agrofor. Systems* **12** : 149-161.

Haigh, H. (1966). Root development in the sandy soil in Zululand. *Forestry in South Africa,* **7**: 31.

Keyes, M.R. and C.C. Grier (1981). Above and below ground net production in 40 years old Douglas-fir stands on low and high productivity sites. *Can. J. For. Res.* **11**(3): 599-605.

Kramer, P.J. (1969). *Plant and soil water relationships - A modern synthesis.* Tata McGraw-Hill, New Delhi.

Mathur, H.N. and H. Raj Francis (1990). Ground water regime under Bluegum at Osamund Nilgiris - Initial observations. *Indian Forester,* **106** (8): 547-554.

Singh, H., M.L. Khybri and P. Joshie (1985). Characteristics of the old riverbed lands in the Doon Valley. *Nat. Seminar on "Recent advances in Soil Science".* Gujrat Agric. Univ., Anand, November 4-7.

Zimmer, W.J. and R.J. Grose (1958). Root systems and root/shoot ratios of seedling of some victorian *Eucalyptus. Aust. For.* **22** : 13-18.

POPLAR BASED AGROFORESTRY INNOVATIONS IN HARYANA

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Introduction

The agricultural fields in the tropical North Indian State of Haryana have become a rich reservoir not only for the food grains but also for the industrial timber. The practice of cultivation of poplars alongside the agricultural crops is a little over a decade old in this region and has become such a passion with farmers that they look no further and are always demanding the ETPs (Entire Transplants) of poplars for planting in their agricultural fields. Poplars are leafless during long winter months and combine very well with most of the agricultural crops. Poplars, however, do not combine with paddy as the latter requires accumulated water for irrigation and the standing water is harmful for poplars. Owing to the higher market price that the poplar wood fetches (about three times that of *Eucalyptus* wood) and certain other factors, the farmers have almost switched over from eucalypts plantation to poplar cultivation. As poplars can be worked on a short rotation of 5-8 years, the farmers do not have to wait for long for realising the returns. Poplars have played a tremendous role in boosting the economy of farmers. Some of the farmers even allow coppice shoots of poplars to come up, though the timber in that case is lighter in weight and fetches less price. An attempt has been made to understand the cropping patterns, vis-a-vis the poplar plantations in the farmers fields and the economic outputs in various agroforestry systems. These findings have been based on the interviews and discussions help with the farmers of Sherpur, Chuharpur Khurd, Balauli and Nahartaharpur villages under Chhachhrauli block of Yamunanagar district (Haryana). These villages have been chosen by the F.R.I., Dehra Dun for extension of agroforestry technology.

Spatial Arrangement

Mainly two locations are assigned to poplars vis-a-vis the farm crops. These are:

Row Planting: Individual farm boundaries are the favourite site for planting poplars in single rows (Fig.1). Planting of trees along North to South direction is less interfering with crops as compared to East-West direction as there is less effect of shade in

Fig. 1

Berseem and mustard crops with row planting of poplars on field bunds

the former owing to the southward tilt of the sun. However, in practice the planting is done in all the possible directions as the farms belonging to different landholders are contiguous to one another. To make the most of the irrigation water channel, staggered rows of closely spaced poplars on both of its sides are also common place. The spacing between the trees in line is 2 to 3 m, though a spacing of 1 m is also seen at places where availability of land is a limiting factor. There is little effect on the crops during the first three years. In subsequent years also the shading effect is mostly confined upto 5 m from the tree line.

Block Planting : Farmers having large landholdings often set aside a good chunk of their land for block planting where intercropping is practiced (Fig. 2). Poplars are planted in compact block at a spacing of 5 m x 4 m which enables the farmers to undertake the tractor-driven agricultural operations without any difficulty. Most of the agricultural crops barring paddy can be cultivated among poplars in blocks. From the third and fourth year of the plantation the tree foliage becomes very dense and it is no more advisable to grow crops as the yields of most of the agricultural crops diminish considerably (Table 1). Shade bearing crops like turmeric thrive well under such conditions.

Temporal Arrangement

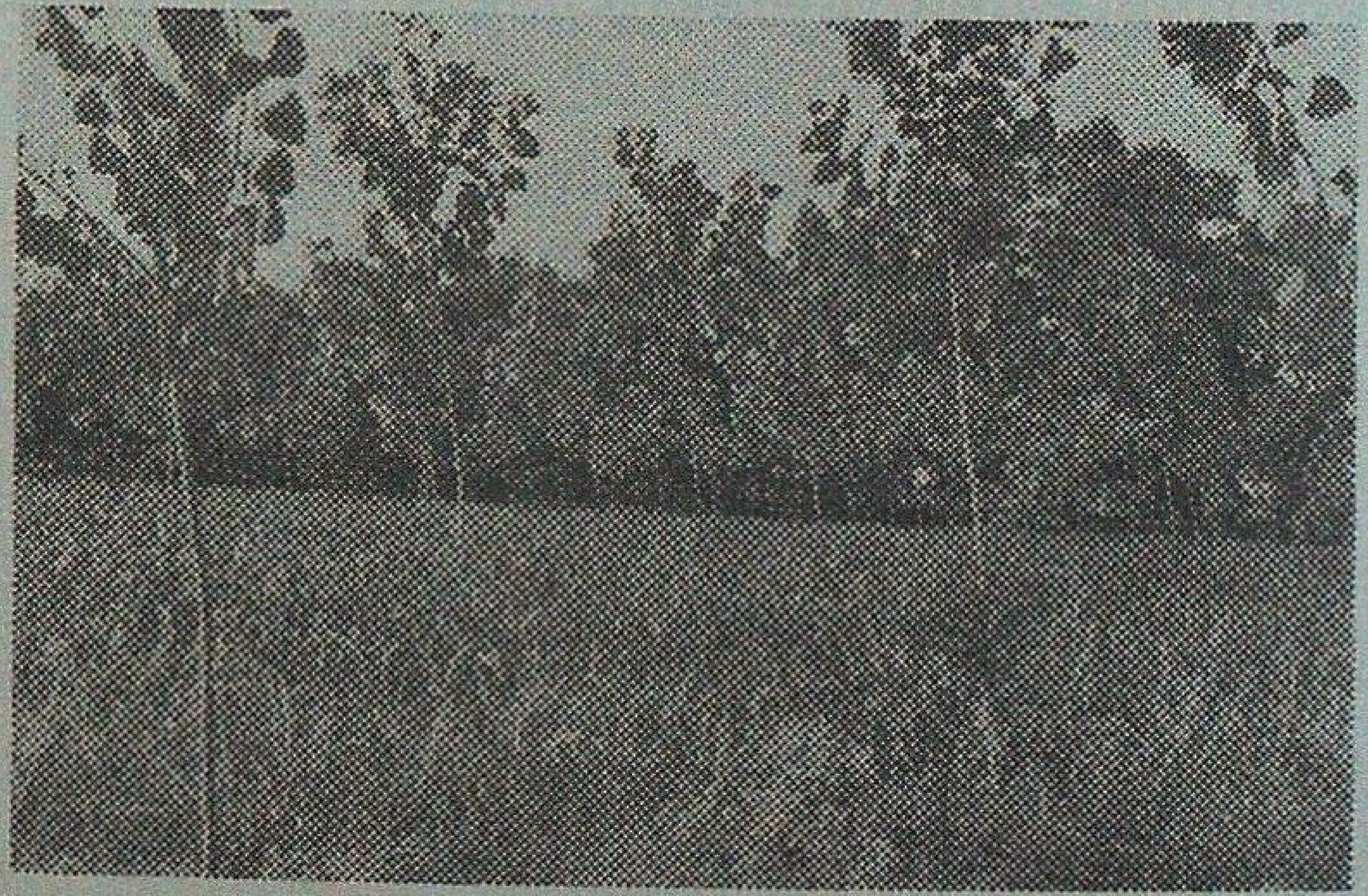
For sustained utilization of the land resources, a variety of cropping sequences with regard to time have been perfected in tandem with poplars. These patterns are more important in case of the block planting because in boundary plantations the farmers can practice the usual cultivation as there is little influence from the trees on the crops. The tree crop interactions yield higher returns to the farmers as compared to pure crop cultivation. Some of the more prevalent systems have been discussed as follows :

(a) *Poplar - sugarcane- wheat-jowar* : Poplar trees interspersed with sugarcane is a common sight in Yamunanagar and other neighbouring districts (Fig. 3). In the first year both poplar and sugarcane are planted in winter. The first year's sugarcane raised from planting fresh stem cuttings is called 'labera' or 'boru'. For the next three years it is repeatedly cut in winter and allowed to sprout from the remaining stumps. In open field it is a common practice for the farmers to burn the sugarcane stumps after

Fig. 2

Block plantation of poplar with freshly germinated wheat as intercrop

Fig. 3



Intercropping of sugarcane with poplar

Table 1

Crop yields on intercropping with poplars

Crop	Yield in quintals per acre				
	Year I	Year II	Year III	Year IV	Year V
Sugarcane	300	250	150	100	-
Wheat	18	18	15	10	Not sown
Lentil	8	8	No more sowing as the leaf fallof poplars hampers germination and sprouting of the crop.		
Jowar	150 (from 2-3 cuttings)	80	50	40	-
Berseem	200 (from 5-6 cuttings)	150	100	No more sowing for aforesaid reason.	
Maize for fodder	100	100	60-70	No more sowing	
Potato	80	70	50	No more sowing	
Pea	60-70	No more sowing			

harvesting as the burning reportedly enhances the sproutings from the stumps. However, with poplars around, the burning is not done. By the 4th year this type of sugarcane (called munda) loses much of its vigour and is cut in October-November.

Fig. 4

Potato intercropped with poplars

Fig. 5

Planting of Poplars Planting of sugar cane	1st Year
↓ ↓	
Suagar cane harvested and sprouted from stumps	2nd Year
↓ ↓	
Sugar Cane harvested and sprouted from stumps	3rd Year
↓ ↓	
Sugar Cane harvested and sprouted from stumps. Premature harvest, Cultivation of wheat	4th Year
↓ ↓	
Cultivation of Jowar (Chari) followed by cultivation of wheat or land left as fallow:	5th Year
↓ ↓	
Land fallow or cultivation of wheat. Felling of poplar	6th year

Poplar - sugarcane - wheat - jowar sequence

Now wheat is sown and is harvested before the succeeding summer. Sowing of jowar (*Sorghum vulgare*) a fodder crop is now done and its several cuttings are taken during the rainy season. In the fifth and sixth year the land is either left fallow or one more crop of wheat is taken. Poplar trees reach the marketable size by now and are felled in 5th or 6th year of planting (Fig. 5).

(b) *Poplar-sugarcane-berseem-jowar* : This system follows the previous system upto the initial three years. In the 4th year the sugarcane is harvested by October and Berseem (*Trifolium alexandrianum*), a fodder herb, is sown thereafter. Throughout the winter and during early summer some 5-6 cuttings of berseem are taken for feeding the livestock. Jowar (*Sorghum vulgare*), another fodder crop, follows berseem and 2-3 cuttings of it are taken before felling the poplar trees. This pattern ensures the advantage of enriching the soil by N-fixation through berseem.

(c) *Poplar - sugarcane - potato - wheat* : In the 4th year the sugarcane is harvested early i.e. by October and a quick crop of early maturing potato is taken during October-December (Fig. 5). Now wheat follows it as described in the first system.

(d) *Poplar - sugarcane - pea - maize* : Unlike the previous pattern, in the 4th year pea replaces potato in this system. After harvesting pea the sowing of maize is done. Maize is grown for fodder and not for the cobs. It provides a useful fodder during summer when other types of fodder crops are not available. It fetches a higher market price of about Rs. 40 per quintal as compared to jowar (rainy season fodder crop) and berseem (winter - spring fodder crop) which are sold for Rs. 30 a quintal. The vegetative growth of maize is excellent as it is sown in spring while the poplars are still leafless.

A number of other crops like sunflower, lentil, oats etc. are also incorporated from time to time depending upon circumstances. Wheat can be sown upto as late as January first week whereas sunflower can be sown still later. As for sugarcane, this can be planted even upto April. Wheat and mustard are often mixed. From 3rd year onwards masoor can both be sown in the compact block planting of poplars because by that time the quantum of falling foliage of poplars becomes enormous and it hampers with the sprouting of lentil seeds as the sowing time of the latter coincides with the leaf fall of poplar. For similar reason it is not advisable to grow other rabi crops like berseem, mustard, pea, potato and wheat in block planting of poplar in later years of plantation. Late sowing varieties of these crops can, however, be sown after the leaf fall is over and the soil has been properly harrowed. In case of peripheral plantation this problem is not much. Shade-bearing crop of turmeric can be taken economically in the later years of block plantation when the canopy become closer. It multiplies under ground luxuriantly if not dug out for 2-3 years after sowing. Gram, which is grown in somewhat drier regions, is not grown in this area owing to high water table and moist soil conditions obtaining here. For similar reasons cobs hardly develop in maize in these areas and the latter is grown only as fodder grass. Lentil and pea need protection from wild animals and hence gown to a limited extent. Paddy which is not grown with poplars in block planting can be grown for initial one or two years with boundary planting of poplars.

Table 2.

Returns of Agriculture crops in combination with Poplars in Yamunanagar.

Crop	Cultivation & Disposal costs (Rs.)	Total output (Qtl.)	Rate per quintal (Rs.)	Total benefit (Rs.)	Net profit (Rs.)
Sugar cane (I year)	8000	300	70	21000	13000
Sugar cane (II year)	3500	250	70	17500	14000
Sugar cane (III year)	3000	150	70	10500	7500
Wheat	3800	18	350	6300	4030
Wheat straw		18	85	1530	
Berseem	2700	200	30	6000	3300
Jowar (Chari)	2600	150	30	4500	1900
Potato	5500	90	150	13500	8000
Lentil	2800	8	1200	9600	6800
Pea	4500	50	250	12500	8000

Economic returns from the Tree Crop Interactions

Poplar have played a great role in augmenting the income of the farmers from their farm lands. Its combination with sugarcane is the most popular agroforestry practice among the farmers, ensuring a return of upto Rs. 14000 per acre per year from sugarcane along (Table 2). Other crops like wheat and potato also offer sizable returns. The returns from growing poplars have been worked out in Table 3. A poplar tree at the end of 5-6 years fetches a price of Rs. 500-600 and a farmer can expect to get over Rs. 1 lakh by extracting poplar wood from one acre of block planting (180-220 trees/acre) as per 1994-95 rates. Before sowing wheat the trees have to be lopped for facilitating germination of seeds. For the growth of sugarcane also it is beneficial to lop the poplar trees just after leaf fall. The pruned wood is used as fuelwood. The timber having girth more than 45 cm is sold for Rs. 150/ quintal whereas the timber with more than 55 cm girth fetch a market price of Rs. 200 per quintal. The wood of lower girth dimension (less than 45 cm) is sold as fuelwood @ Rs. 50/ quintal. It may be noted that the lease value for renting out the land in these regions is to the tune of Rs. 5000/acre/year. Chandra (1986) has calculated the cost benefit analysis for poplar plantation with intercropping in U.P. Tarai and has found excellent Internal Rate of Return (I.R.R.) of the order of 39.22 (Table 4) inspite of extension costs charged by WIMCO. Owing

Table 3

Returns from poplars in agroforestry systems in Yamunanagar in block plantation of 1 acre.

Year	Plantation cost (Rs.)	Total Benefits (Rs.)	Remarks
I	4000	-	180-200 trees will survive after 5-6 years and will fetch Rs. 500-600 per tree
II	1200	-	
III	1000	125	
IV	800	200	
V	500	300	
VI	500	100000	

Table 4

Cost benefit analysis of 1 ha poplar (G-3, G-48 or D-121) plantation in Uttar Pradesh Tarai.

Year	Cost of Plantation (Rs.)	Total cost * including opportunity cost against Agri. loss. (Rs.)	Discount at interest		Total Benefit	Discount at interest	
			12%	15%		12%	15%
I	11760	11760	10500.00	10226.09			
II	3382	8382	6682.08	6338.00	3000	2391.58	2268.43
III	2951	7951	5659.48	5228.17	2000	1921.85	1775.38
IV	2960	7960	5059.11	4551.43	2240	1423.67	1280.81
V	2960	7960	4517.08	3957.84	2320	1316.54	1154.54
VI	2960	7960	4033.24	3441.72	2400	1216.05	1037.70
VII	900	5900	2669.20	2218.30	2000	904.81	751.96
VIII	900	5900	2383.26	1928.99	172000	69478.11	56234.88
Total	28773	63773	41503.45	37890.54	185960	77336.07	64502.70
Net Present Value			-	-	-	35832.62	26612.16
Net Present Value (per year/per ha)			-	-	-	4479.08	3326.52
Benefit/Cost Ratio			-	-	-	1.86	1.70
Internal Rate of Return			-	-	-	39.22	-

* Including Rs. 5,000.00 as apportunity cost against a net loss due to not getting agricultural crop, which is neglected during first year.

to the prolonged period of leaflessness during winters (from December to March) the winter crops combine very well with poplar and the latter finds great favour with the farmers. In case of sissoo, the actual period of leaflessness lasts hardly a month (from mid February to mid March) which is not so conducive for the crops as it causes dryness in summer and shade in winter.

Poplar wood is being mostly used as Plywood, matchwood, fuelwood and spoons. Though it is excellent for paper making as well, it is not being used that way because much cheaper alternatives like eucalypts and bamboos are available for paper making. G-3 and G-48 clones of poplars have been found to perform well in these areas. Some more clones like S7C15, S7C8, St-67 etc. also have shown promise on the basis of early evaluation of their plantation trials in the farmers fields. The timber obtained from block plantation reportedly fetches some what higher price as compared to peripheral plantation. It appears to have an edge over the other due to getting more care by way of irrigation, fertilizer etc. applied to agricultural crops.

Acknowledgements

The author is grateful to K. Ram and S. Nautiyal of Poplar Research Centre for their assistance in recording the agroforestry data from the field and for collecting valuable information from the farmers. The farmers who participated in the whole activity are Sant

Prakash Singh and Sher Jung Singh of Nahartaharpur, Ran Singh and Dharam Pal Singh of Sherpur, Man Mohan Singh and Kulvinder Singh of Balauli and Mam Raj and Dhoom Singh of Chuharpur Khurd among others. Their participation is thankfully acknowledged.

SUMMARY

Poplars are being increasingly used by the farmers of Haryana for raising short rotation, high yielding, industrial plantations in their agricultural fields. A number of poplar based agroforestry practices have been perfected by the farmers with regard to space and time sequence for the agricultural crops in order to optimise the economic returns, vis-a-vis the sustained utilization of the land resources. Poplars along with sugarcane, wheat and jowar constitute one of the most beneficial tree crop combination adopted by the farmers. A spacing of 5 m x 4 m has been found excellent for block planting whereas in row planting the trees are spaced at 1 m to 3 m apart. Poplars are known to give higher returns to the farmers as compared to other tree species.

पोपलर आधारित कृषिवानिकी की हरियाणा में नवीनताएँ

डी०सी० कर्णाटक

सारांश

छोटे आवर्तन, अधिक उत्पादन देने वाले औद्योगिक रोपवनों के लिए हरियाणा के किसानों द्वारा अपने खेतों में पोपलर को अब अधिकाधिक लगाया जा रहा है । भूमि संसाधनों का सतत् आधार पर उपयोग करने के साथ-साथ अपने आर्थिक लाभों को इष्टतम बनाने के लिए कृषि फसलों को लगाने के जगह और समय अनुक्रम को भी किसानों ने पोपलर पर आधारित कृषि वानिकी कार्यों के लिए कई प्रकारों में सर्वोत्तम बना लिया है । गन्ना, गेहूँ और ज्वार के साथ मिलाकर पोपलर को लगाना सबसे अधिक लाभकारी वृक्ष संयोगो में आता है । जिन्हें किसानों ने अपना लिया है । खण्ड रोपण के लिए 5 मी० x 4 मी० का फासला छोड़ना सबसे ज्यादा अच्छा पाया गया है जबकि पंक्ति रोपण करने के लिए वृक्षों को 1 मी० से 3 मी० फासला छोड़कर लगाया जाता है । अन्य वृक्ष जातियों की तुलना में किसानों को पोपलर लगाने से अधिक प्राप्ति मिलती सूचित की गई है ।

FUNGAL DISEASES OF *EUCALYPTUS* FROM ANDHRA PRADESH - I

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Introduction

Eucalyptus, in view of its versatility and agroforestry importance, is grown extensively all over the world amidst of much vilification and obloquy. However, some fungal disease problems have become limiting factors (Tewari, 1992). It is reported to be victim of several fungal diseases both at seedling stage (Bakshi, 1976; Sharma and Mohanan, 1982; Sharma *et al.*, 1984) and standing tree (Bakshi, 1976; Neumann and Marks, 1976; Kale, 1977; Sharma and Mohan, 1982 and Sharma *et al.*, 1984) have reported several leaf-spot diseases which affect the plant productivity. In the course of investigations on decline of *Eucalyptus,* the authors have recorded some rare and new diseases hitherto unrecorded from India. They are described in this communication.

Materials and Methods

A periodical survey of *Eucalyptus* plantations in this part of India was made and the diseased leaves were collected in sterilized polythene bags. Symptoms were recorded carefully and same were brought to laboratory for further processing. The pathogens responsible for diseases were isolated on PDA slants after surface sterilization with ethyl alcohol as suggested by Bilgrami (1963). The hyphal tips coming out of the infected leaf bits were picked and transferred to a fresh agar slant. The fungi were identified with the help of standard monographs (Barnett and Hunter, 1972; Sutton, 1980) after purification of culture. The identifications were further confirmed by Commonwealth Mycological Institute, Kew, England. The fungus isolated was claimed as a pathogen only after fulfilling Koch's postulates.

Observations

Phaeoseptoria Leaf Spot

Symptoms : A severe leaf spot disease of *Eucalyptus tereticornis* was observed during November to February on the mature leaves. The leaf spot was first initiated either from the apex or margin and at advanced stage the infection may spread to young leaves. The leaf spot was bordered by purple to violet coloured band (Fig. 1). Pycnidia with a large mass of Pycnidiospores were formed on both the sides of the leaf. The infected portion which later coalesced to form a bigger spots. Premature defoliation was also a common feature. Scrapings of the infected spots revealed it to be *Phaeoseptoria eucalypti* (Hansf) Walker on microscopic examination.

Morphology of the pathogen: Pycnidia dark, scattered on the infected portions,

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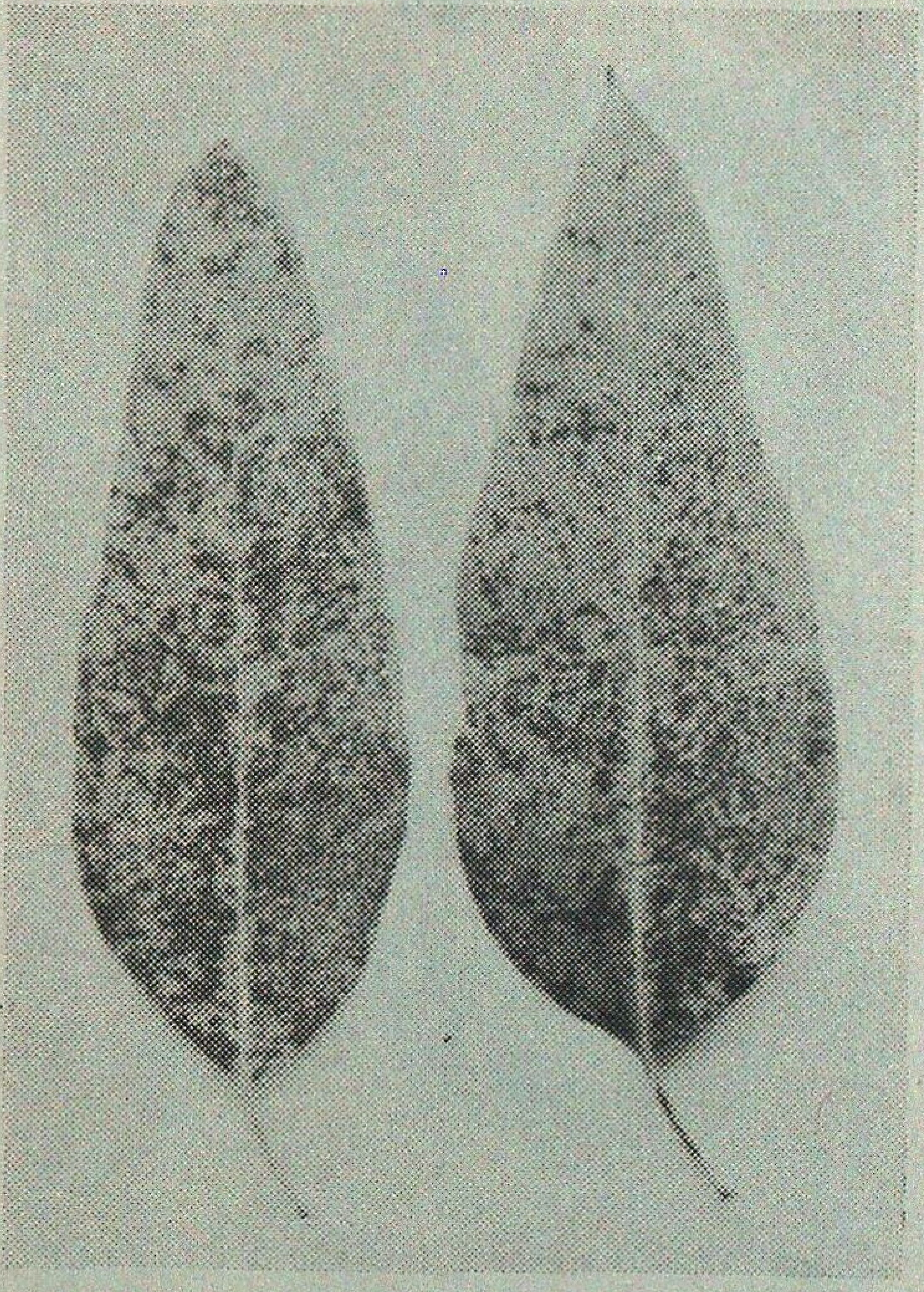
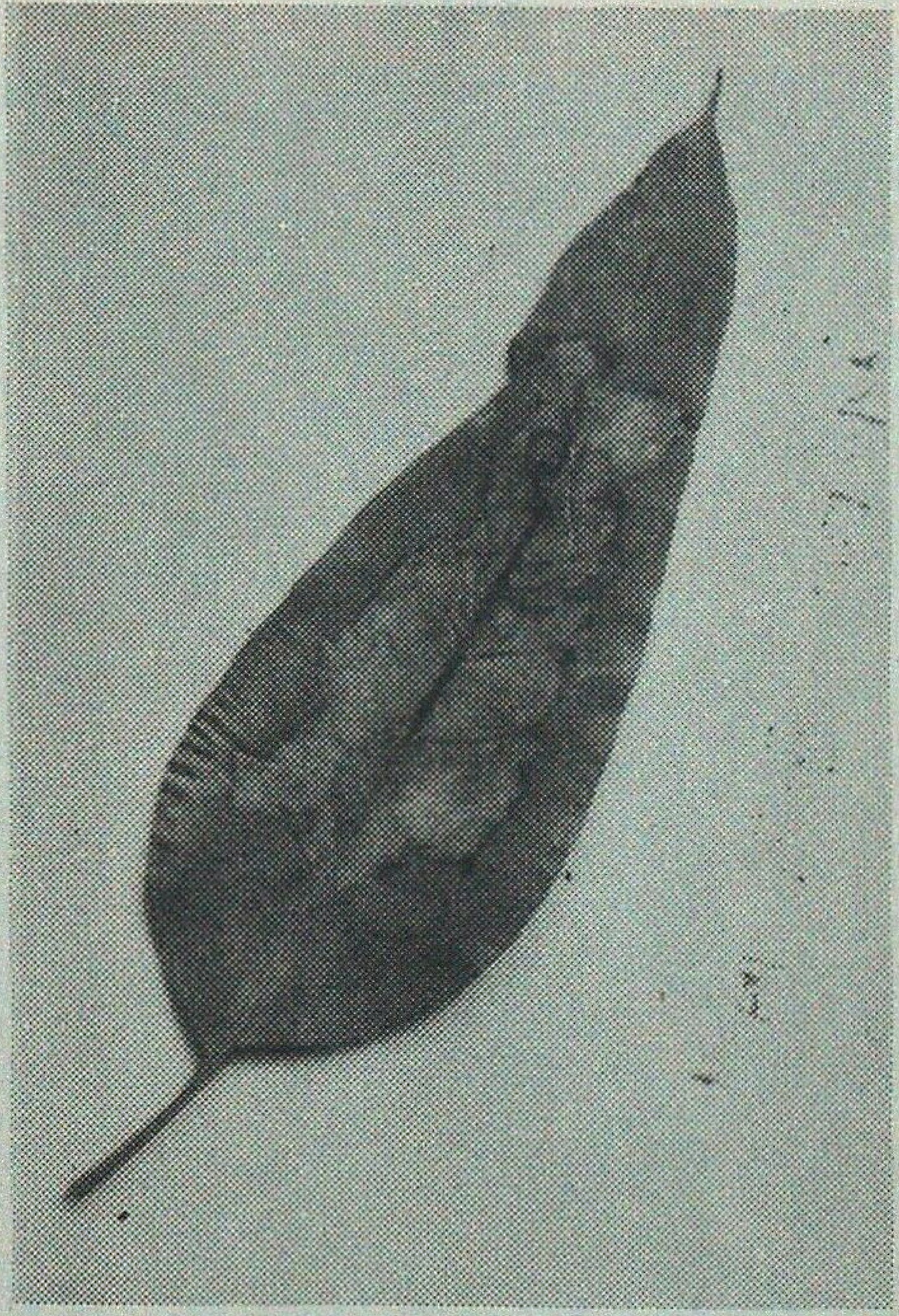
Fig. 1



Leaf of *Eucalyptus tereticornis* showing symptoms produced by *Phaeoseptoria eucalypti.*

Fig. 2



Leaf of *Eucalyptus camaldulensis* and *E. tereticornis* showing the symptoms caused by *Seimatosporium discosioides.*

subepidermal or erumpent, embedded in the leaf tissue, spherical, separate, narrowly ostiolate; conidiophores simple, short, conidia produced by simple conidiophores with rounded to subtruncate base; conidia yellowish to light-brown, dark-black to olivaceous-brown in mass, elongate to filiform, several-called, 200-725 x 3-8 µm.

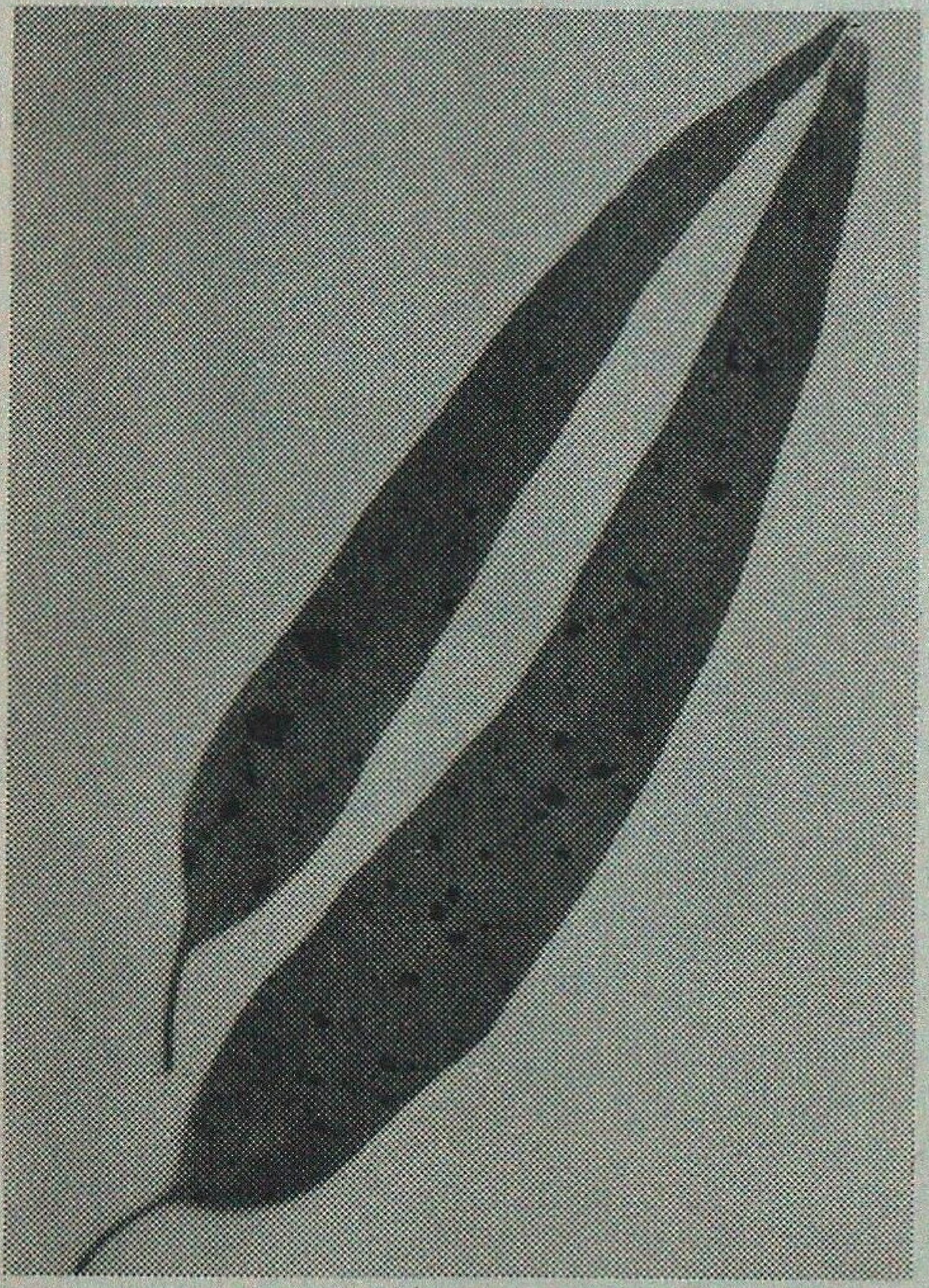
This disease earlier was reported by Padaganur and Hiremath (1973), Sharma *et al.* (1985) and Jamaluddin *et al.* (1985) from Karnataka, Peechi (Kerala) and Jabalpur (M.P.) respectively.

Seimatosporium Leaf Spots

Six years old plants of *E. camaldulensis* and *E. tereticornis* growing in Bhopal pally, Inugurthy and Rampur (A.P.) during December to February exhibited severe leaf spots. The disease initiated as a small discolouration on the lamina which increased in size and turned brown in colour with the age of the disease. Adjacent spots fused to form irregular lesions (Fig. 2). At advanced stage, small microscopic fruit bodies appeared on the upper surface of the leaf. Repeated isolations from such spots and microscopic examination revealed it to be *Seimatosporium discosioides* (Ell. & Everh.) Shoem (IMI 357390).

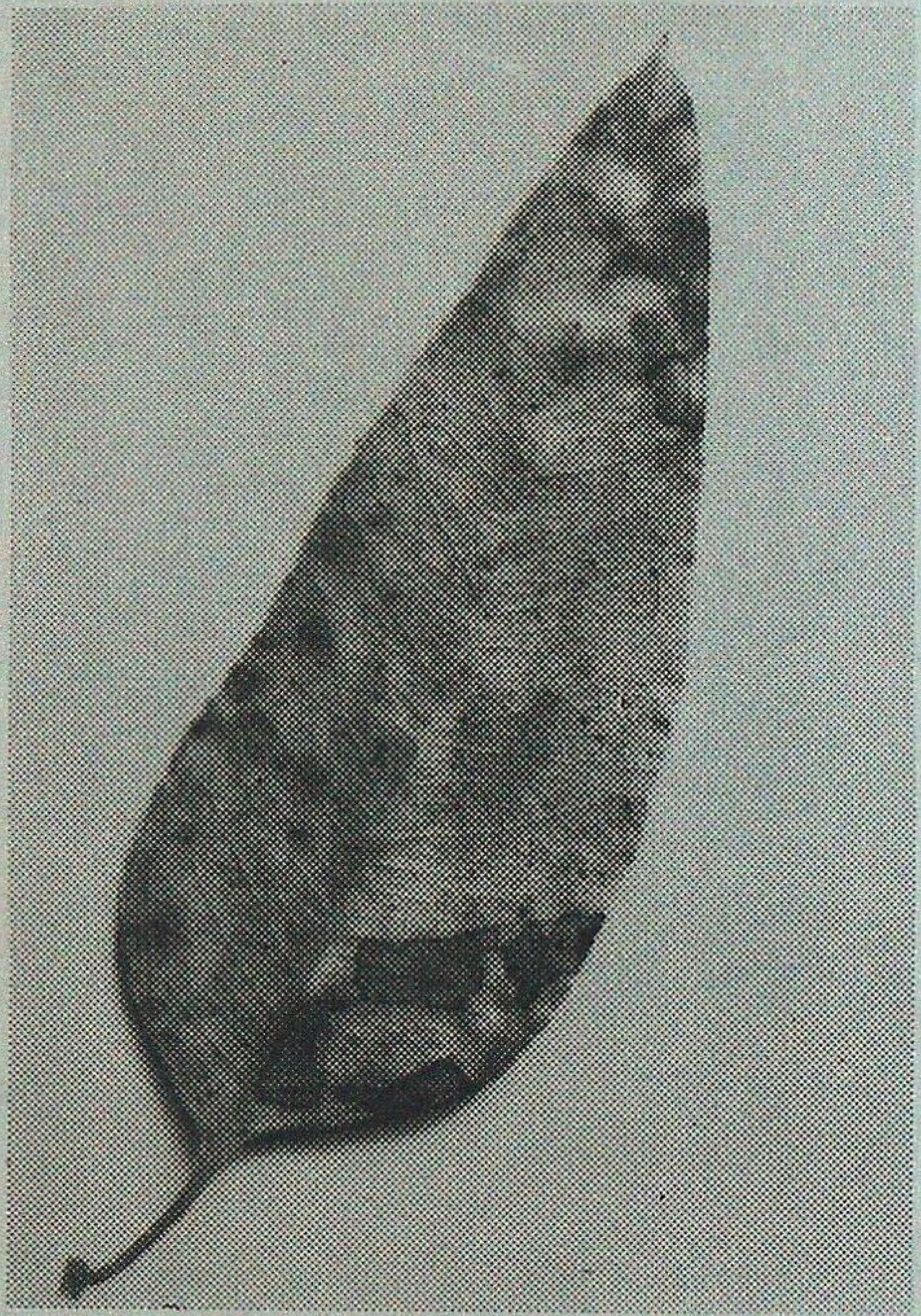
Morphology of the pathogen : Colonies spreading, hyaline at pale-brown; hyphae hyaline, septate, branching, 2.8-8.5 µm wide; conidiophores acervular, brown, upto 210 µm dia; mconidiophores cylindrical, septate, branched, hyaline, filiform, formed from the upper cells of the conidiomata;

Fig. 3



Leaf of *Eucalyptus camaldulensis* showing the symptoms caused by *Seimatosporium falcatum*.

Fig. 4



Leaf of *Eucalyptus tereticornis* showing the symptoms produced by *Bartalinia robillardoides*.

conidiogenous cells holoblastic annellidic (usually 1-2 annellations), 10-15 x 2-3µm in size; conidia 11.0-19.5 x 3 - 5 µm; cylindrical, fusiform, 3-septate, curved, median cells pale-brown; apical cell with a short appendage 2.5-8.0 µm long; basal cell with a short appendage, 2.0-6.0 µm long.

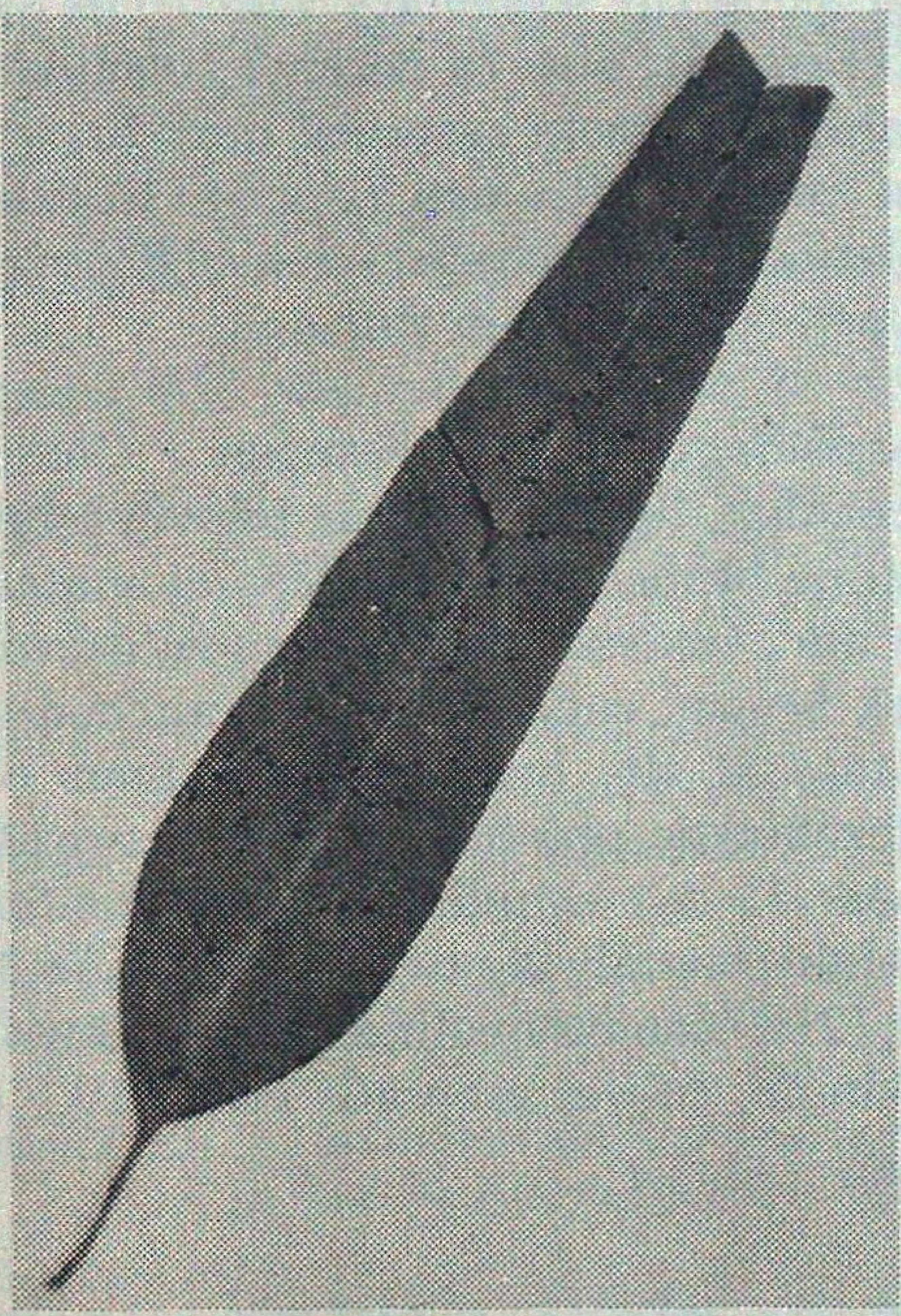
Leaves of *E. camaldulensis* showing small, dark coloured and scattered spots on the lamina of the leaf were also collected from Inugurthy, Pedda Pendyal (Warangal) and Kangaznagar (Adilabad). The leaf spots were irregular in shape and dark coloured. The spots were limited in size (Fig. 3).

Isolation from such spots yielded highly sporulating culture of another species of *Seimatosporium* i.e., *S. falcatum* (B. Suttan) Shoem. (IMI 360859).

Morphology of the pathogen : Colonies spreading, hyaline to pale brown; hyphae hyaline, branched, septate, 2.8-8.5 µm wide; conidiomata acervular, brown, upto 225 µm dia; conidiophores cylindrical, septate, branched, hyaline, filiform, formed from the upper cells of the condiomata; conidiogenous cells holoblastic 5-10 x 1-2 µm long, usually without any annelations. Conidia 28 - 49.5 x 2.5 -8.5 µm, 3-septate, falcate, median cells pale-brown 15-32.5 µm long; apical cell long, conic, very pale-brown with a short appendage, 2.5-15 µm long, basal appendage 2.5-12 µm long.

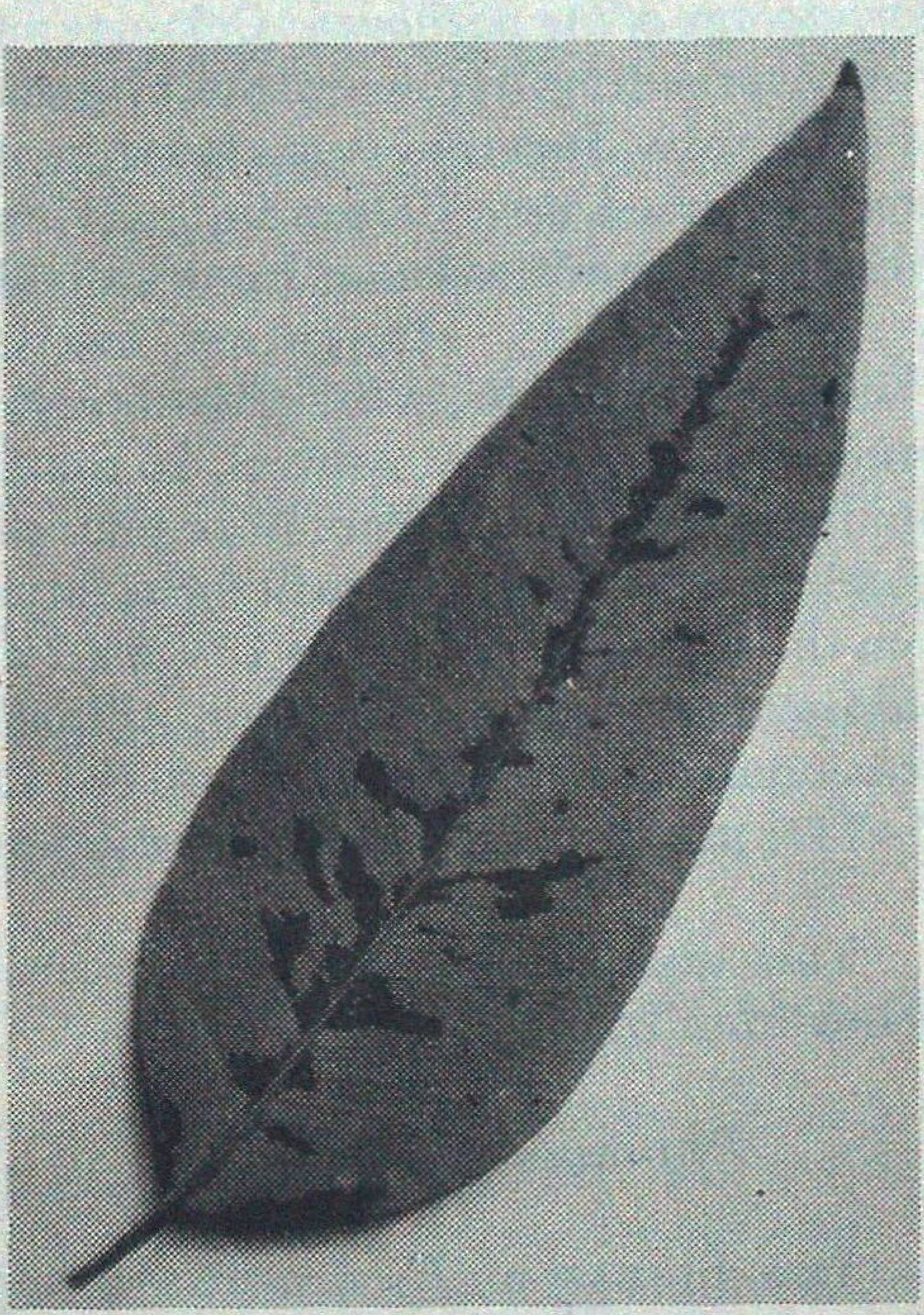
This disease was earlier reported by Swart (1982) from Australia. Both the diseases are recorded for the first time from India (Bilgrami *et al.*, 1979).

Fig. 5



Leaf of *Eucalyptus camaldulensis* showing symptoms caused by *Haplosporella beumontiana.*

Fig. 6



Leaf of *Eucalyptus grandis* showing symptoms caused by *Phomopsis eucalypti.*

Bartalinia Leaf Spot

Purplish-brown scattered spots were observed on many leaves of *E. tereticornis* growing at Warangal. The infection started as discolouration which gradually turned to purple and then changed to brownish-purple with age. Marginal spots were also common (Fig. 4). *Bartalinia robillardoides* (Tassi) was responsible for this disease.

Morphology of the pathogen : Colonies white, spreading; hyphae branched, septate, hyaline, 2.5-5.5 µm wide; condidiomata immersed, globose to subglobose, scattered or gregarious, unilocular, brown to dark-brown, ostiolate 175-300 µm dia; conidiogenous cells simple, cylindrical to obclavate, hyaline 6-8.5 x 3-4.5 µm, annellidic with apical percurrent proliferations; condia holoblastic, acrogenous, solitary, cylindrical to fusiform, straight, 20.0-28.5 x 4.5 µm, 4-septate, hyaline, with a bi - or tirfurcate apical hyaline appendage, 10-21x1-1.5 µm long, basal appendage 6.5 µm long. Culture deposited in CMI, Kew, England (IMI 357392).

This disease earlier was reported by Ponappa (1970) from Karnataka.

Haplosporella Leaf Spot

Plants of *E. camaldulensis* at Inugurthy, Warangal have exhibited pin head size scattered leaf spots all over the lamina during December to February. The spots were restricted in size (Fig. 5.) Microscopic observations and scrapings from such spots revealed it to be *Haplosporella beaumontiana* (Ahmad).

Morphology of the pathogen : Colonies pale-brown, spreading; hypae septate, branched, 2.5-14.0 µm wide conidiomata eustromatic, semi-immersed, upto 700 µm dia., pulvinate, dark-brown, multicellular, locules divided by pale-brown, elongated textura prismatica, but unite in the ostiolar region; ostiole single, circular, central, 75 µm dia; conidiophores absent, conidiogenous cells holoblastic discrete, hyaline filiform, formed from the walls, of the locules 15 -18 x 2 µm; conidia dark brown, aseptate, ellipsoid, occasionally quttulate, verrucose, 16 - 21 x 11 - 11.5 µm, paraphyses 25 - 60 x 1.5 µm.

This disease has note been recorded earlier from India.

Phomopsis Leaf Spot

The plants of *E. qrandis* during September to January exhibited severe leaf spot disease which initiated in the mid-rib and along the secondary veins. The spots increased in size to become irregular in shape. The spots assumed dark-brown to tan colour with age (Fig.6). Repeated isolations from such spots yielded *Phomopsis eucalypti* (Zerova) in culture.

Morphology of the pathogen : Colonies spreading, hyaline to pale-brown, hyphae hyaline, branched, septate; conidiomata 850 µm dia., eustromatic, immersed, brown to dark brown; conidiophores branched and septate at the base. conidiogenous cells enteroblastic, phialidic; conidia of two basic types (1) α - conidia hyaline, fusiform, straight, usually biguttulate 4.0 - 6.5 x 1 - 2 µm, (2) β - condia hyaline, filiform, hamate or simply curve, aseptate 11.0 - 19.5 µm long.

This disease has not been reported from India.

Acknowledgements

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SUMMARY

Leaf spot diseases of *Eucalyptus* **caused by** *Phaeoseptoria eucalypti, Seimatosporium discosioides, S. falcatum, Bartalinia robillardoides, Haplosporella beaumontiana* **and** *Phomopsis eucalypti* **are described. All the above diseases are recorded for the first time either in this region or in India.**

आन्ध्र प्रदेश से युकेलिप्टस के कवक रोग

आर०वाई गिरि, एम०आर० भंज व एस०एम० रेड्डी

सारांश

फिओसेप्टोरिया युकेलिप्टी, सायिमाटोस्पोरियम डिस्कोसिआयडिस, सा० फाल्केटम, बार्टलिनिया रोबिल्लार्डोआयसिस, हैप्लोस्पोरेल्ला बोमोण्टियाना और *फोमोप्सिस युकेलिप्टी* से होने वाले युकेलिप्टस के पर्ण लांछन रोग का वर्णन किया गया है । ऊपर बताए इन सभी रोगों को इस क्षेत्र में अथवा भारत में पहली बार होता सूचित किया गया है ।

References

Bakshi, B.K. (1976). *Forest Pathology - Principles and practice in Forestry.* Controller of Publications, Delhi.

Barnett, H.L. and B.B. Hunter (1972). *Illustrated genera of imperfect fungi.* Burgess Publishing Company, U.S.A.

Bilgrami, K.S. (1963). Leaf spot diseases of some common ornamental plants. *Proc. Natl. Acad. Sci.* (India) **33 B**: 429-452.

Bilgrami, K.S., Jamaluddin and M.A. Rizwi (1979). *Fungi of India,* Part I. Today and Tomorrows Pri. and Publ. New Delhi, 1-467.

Jamaluddin; K.K. Soni, and V.S. Dadwal (1985). Leaf blight of *Eucalyptus* in nurseries, *Indian Forester,* **111** (12) : 1136-1138.

Kale, R.B. (1977). *A note of Eucalyptus fungus investigation project,* Kerala. Hindustan Paper Corn. Ltd., New Delhi.

Neumann, F.G. and G.C. Marks (1976). A synopsis of important posts and diseases in Australian forests and Forest nurseries. *Aust. For.,* **39** : 83-102.

Padaganur, G.M. and P.C. Hiremath (1973). *Phaeoseptoria eucalypti* Hansf., A new record to India, *Mysore. J. Agric. Sci.,* **7** : 336-337.

Ponappa, K.M. (1970). Some interesting fungi. *Proc. Ind. Acad. Sci.* **71 B** : 66-77.

Sharma, J.K. and C. Mohanan (1982). *Cylindrocladium* Sp. associated with various diseases of *Eucalyptus* in Kerala. *European Jour. of Forest Path.* **12** (3) : 129-136.

Sharma, J.K., C. Mohanan and E.J. Maria Florance (1984). A new stem canker disease of *Eucalyptus* caused by *Botryodiplodis theobromae* in India, *Trans. Br. Mycol. Soc.,* **83** :162-163.

.... (1985). Disease survey in nurseries and plantations of forest tree species grown in Kerala, *Research Report.* **36**, K.F.R.I., Peechi, Kerala, India.

Sutton, B. (1980). *The Coelomycetes,* CMI, Kew.

Swart, H.J. (1982). Australian leaf inhabiting fungi XIII. *Seimatosporium* species on *Eucalyptus. Trans. Brit. Mycol. Soc.,* **78** : 265-269.

Tewari, D.N. (1992). *Monograph on Eucalyptus,* Surya Publication, Dehra Dun, India.

Snippets SMALLER COMPUTER CHIPS

Microlithography using neutral atoms instead of light to write patterns on silicon could make it possible to manufacture integrated circuits 10 times smaller than is currently possible. A beam of argon atoms is directed through a copper grid; atoms write patterns on a gold surface coated with a photosensitive resist. Atoms hitting the resist break chemical bonds and gold underneath is washed away with a chemical bath. The grid of gold lines, a few micrometers wide, can be chemically transferred to silicon.

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EFFECT OF CONE DIAMETER ON SEED YIELD, MOISTURE CONTENT AND GERMINATION IN HIMALAYAN BLUE PINE (*PINUS WALLICHIANA* A.B. JACKS)

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Introduction

Blue pine (*Pinus wallichiana* A.B. Jacks) is found growing throughout the temperate regions of the Western Himalayas, located between 1750-2500 m and sometimes forms pure stands (Troup, 1921). Inspite of its tendency to form pure crops, the blue pine frequently occurs mixed with other species. At lower elevations, it is generally associated with *Pinus roxburghii* and *Quercus leucotrichophora* and at higher elevations with *Abies pindrow, Picea smithiana* and *Quercus semecarpifolia.* Among conifers, at lower and higher altitudes, the frequent companion of blue pine is *Cedrus deodara.*

Cones possessing higher volumes contribute great significance in obtaining higher yield of quality conifer seeds (Maheshwari and Konar, 1971). Forestry being a long term proposition, the use of high quality seeds assumes greater importance, because population raised from genetically inferior seeds can only be detected after a long period, when the crop attains capability to exhibit genotypic and phenotypic variations and is able to provide the expected yield (Singh *et al.*, 1970). Information is available on seed production and germination in *Pinus roxburghii* (Sagwal, 1984), but no systematic work, so far dealing with the cone diameter and its inter-relationship with factors like seed moisture content, seed yield and germination characteristics etc., has been done. These characters may show considerable intraspecies variations as has been reported by Eliason and Heit (1940) and Langdon (1958).

In order to ascertain these parameters, the present study was, therefore, undertaken to determine optimum cone size, so as to obtain higher yields of quality seed and germination in blue pine *(Pinus wallichiana).*

Materials and Methods

The cones of blue pine were collected from Lohital Reserve Forest (Compartment No. 12a) at an altitude of 2000 m in Tehri Range of Tehri Forest Division of Uttar Pradesh, situated between 30^{0}C 15' N latitude and 78^0 25' E longitude. A plot of 100 x 100 m size was laid down and sixty trees with well developed crown were selected for the collection of cones and twenty five cones of different sizes were randomly collected manually from each tree. Depending upon the available cone diameter (taken from the middle of each cone), the cones were grouped into three diameter classes consisting of :

(i) Small (- < 3.0 cm diameter),
(ii) Medium, between 3.0 to 3.5 cm diameter and,
(iii) Large (- > 3.5 cm diameter).

While selecting experimental material deformed, damaged or insect infested cones were culled.

Each diameter class consisted of four hundred cones, was taken as a unit for each treatment. The cones in each diameter category were weighed and average weight per cone was calculated. The cones of each category were dried separately in sunlight till they started opening. The seeds were extracted manually, air dried for 24 hrs and weighed to the nearest grams. For estimating average seed yield per cone, the extracted seed lot obtained from each diameter class was divided by the number of cones. The per cent yield was determined by dividing the seed weight (kg) by green weight of cones (kg) and multiplying the value by 100. The number of cones required to get one kg of seed were calculated from average seed yield per cone.

For determining the moisture content of seed, 800 seeds in each category, comprising of 8 replications and 100 seeds under each replication were weighed in monopan balance. The seeds were dried in oven at 80^0 C till they exhibited constant weight and weighed. The moisture content was calculated on wet basis as recommended by ISTA (Anon. 1966).

For carrying out germination studies, 100 seeds were used in each replication, and treatments were replicated six times. The seeds were sterilized by placing them in 0.01% mercuric chloride solution for 5 minutes and were rinsed thrice in distilled water prior to their placement into germination medium, i.e., distilled water (Singh, 1989). In order to expose the seeds to homogenous conducive conditions for germination, the seeds were placed on moist filter papers affixed on petridishes. The seed samples were placed in BOD incubator at 20^0C (Singh, 1986). Protrusion of radicle was considered as the criterion of seed germination. The germination value was calculated on the basis of formula described by Djavanshir and Pourbeik (1976):

Germination Value = (Final DGS/N) x (Final cumulative germination %/10) Where DGS is the daily germination speed and N denotes to the number of counts. To compare the germination obtained in the laboratory seeds were also sown in the nursery in 1 m^2 bed containing six lines at 15 cm apart. One hundred seeds were sown in each line on April 2, 1991 for each diameter class. The sowing was replicated six times. The germination was completed by May 22. For analyzing the results statistically the method suggested by Snedecor and Cochran (1967) was followed after the arc sine transformation of germination and moisture percentage data.

Results and Discussion

Inter-comparison of the results obtained from fresh weight of cones, seed weight per cone, seed yield and number of cones required for extracting 1 kg of seeds for different diameter classes have been presented in Table 1.

The data indicates that weight of fresh cones as well as weight per cone increased with the increase in cone diameter. The total seed extracted from the cones of small, medium and large diameter classes was 688.00, 1368.00 and 1984.00 gm, respectively. The seed quantity was found

Table 1

Fresh weight of cones, seed weight/cone, seed yield and number of cones required for extraction of 1 kg of seeds from different diameter classes of blue pine.

Cone diameter classes (cm)	Fresh wt. of cones* (kg)	Fresh wt./ cone (gm)	Total seed extracted (gm)	Seed extracted/cone (gm)	Per cent yield	No. of cones required for extraction of 1 kg of seed
Small (- 3.0)	28.00	70.00	688.00	1.72	2.457	581.39 (581)
Medium (3.0 - 3.5)	46.80	117.00	1368.00	3.42	2.923	292.39 (292)
Large (- 3.5)	74.80	187.00	1984.00	4.96	2.652	201.61 (202)

* Cone weight based on 400 cones, Data in parenthesis denote No. of cones in round figure.

almost three times more in large cones as compared to smaller cones. The lowest seed yield per cone was noted under small size cones (1.72). However, the per cent yield was higher in medium size cones (2.923%), than those of large (2.652%) and small size cones (2.457%). Seed yield variations, have also been reported by different workers on different pine species. The seed yield varied between 2.0 - 4.0 per cent in *P. nigra* (Anon., 1948). Read (1932), reported that the seed yield in *P. engelmannii* was 1.1, whereas, it was 2.0 - 4.0 per cent in *P. palustris* and 2.0 - 3.0 per cent in *P. strobus* (Anon., 1974).

A perusal of data presented in Table 1 also revealed that the number of cones required for extracting 1 kg of seed decreased proportionately with the increase in cone diameter and the maximum cones (581.39) were required to extract 1 kg seed weight in smaller cone category while it was found minimum with large size cones (201.61).

Fresh and dry weight of seeds increased with the increase in cone diameter as it appears from the data presented in Table 2. The maximum fresh (67.29 mg/seed) and dry (58.77 mg/seed) weight per seed was noted with the seed extracted from large size cones, while it was found minimum with the seeds extracted from smaller cones (fresh weight/seed 48.01 mg and dry weight/ seed 44.37 mg). The increase in cone diameter also resulted an increase in moisture content of the seeds. Increased moisture content with the large size cones might be due to the larger seed size.

The data presented in Table 3 indicates that the maximum seed germination (62.50%) was observed from seeds of medium diameter class and minimum in small size cone (50.25%). The seeds obtained from large size cones gave 60.00% germination under laboratory conditions. The germination value also followed the same trend as germination percentage. Statistical analysis of germination data showed that the germination percentage obtained from seeds of small and medium, large and small cone size differed significantly with each other at 1% level but no significant difference was observed in seed germination obtained from medium and large size cones. The maximum germination (54%) in the nursery was obtained from medium size cones followed by large (49.50%) and small size cones (40.50%). Statistical analysis of data indicated that seed germination obtained

Table 2

Weight and moisture content of seeds extracted from different diameter classes of blue pine cones.

Cone diameter classes (cm)	Fresh wt. of 100 seeds (gm)	Fresh wt./ seed (mg)	Dry wt. of 100 seeds (gm)	Dry wt./ seed (mg)	Moisture percentage
Small - (-<3.0)	4.801±0.491	48.01	4.437±0.460	44.37	7.582±0.366
Medium (3.0-3.5)	5.340±0.373	53.40	4.840±0.346	48.40	9.363±0.681
Large (->3.5)	6.729±0.269	67.29	5.877±0.304	58.77	12.662±1.287
					C.D. at 1% = 0.90

Table 3

Germination and germination value of blue pine seed from different diameter classes.

Diameter classes (cm)	Germination percentage		Germination value (GV)**
	Laboratory	Nursery	
Small (-<3.0)	50.25±4.79	40.50±5.39	7.80
Medium (3.0-3.5)	62.50±7.94	54.00±8.79	11.81
Large (- >3.5)	60.00±5.10	49.50±6.05	11.64
C.D. value at 1%	6.96	5.83*	

*C.D. value at 5%, **GV under laboratory condition

from medium and large size cones did not differ significantly at 5% level but it was significant in case of small size cones as compared to medium and large size cones at 5% level of significance. These findings are in accordance with the results reported by Rafn (1915), who obtained 64.00% germination of mixed seed lot of blue pine under laboratory condition without pretreatment. Based on the findings obtained from the present investigation, it may be concluded that medium size cones be collected for getting quality seed and higher germination.

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SUMMARY

The present study was aimed at, to find out the effect of different cone diameter classes (Small - < 3.0 cm; medium, 3.0 - 3.5 cm; and large - > 3.5 cm) on various parameters. The medium size cones exhibited higher germination followed by large size and small size cones in the laboratory as well as in the nursery. The large size cones were found superior in terms of fresh weight of cones, quantity of seed extracted, fresh and dry weight of seeds and moisture content, respectively. However, the maximum per cent seed yield was obtained from the medium size cones. The number of cones required to get unit quantity of seed decreased as the diameter of cones increased. Therefore, it may be recommended that medium size cone be preferred for seed collection in order to obtain maximum germination in blue pine.

शंकु के व्यास का हिमालयी चीड़ (*पाइनस वालिसियाना* ए०बी० जैक) की बीज प्राप्ति, नमी तत्व और अंकुरण पर प्रभाव

वीरेन्द्र सिंह, वी०के० शाह व ओ०पी०एस० बाना

सारांश

प्रस्तुत अध्ययन का लक्ष्य विभिन्न व्यास श्रेणियों (छोटी 3.0 सेमी०, मध्यम 3.0 से 3.5 सेमी० और बड़ी 3.5 सेमी०) के शंकुओं का विभिन्न परिमापों पर प्रभाव मालूम करना था । मध्यम आकार वाले शंकुओं का अंकुरण प्रयोगशाला और क्षेत्र दोनों जगह सबसे अधिक पाया गया जिसके बाद बड़े शंकु और उससे पीछे छोटे आकार के शंकु रहे । शंकुओं के ताजा भार, उनसे निकले बीजों तथा बीजों के शुष्क भार तथा नमी तत्व की दृष्टि से बड़े आकर वाले शंकु क्रमशः श्रेष्ठतर पाए गए । तथापि, बीज प्राप्ति का अधिकतम प्रतिशत मध्यम आकार के शंकुओं का रहा । एक निश्चित संख्या की इकाई में बीज प्राप्त करने के लिए आवश्यक शंकुओं की संख्या शंकुओं का आकार बढ़ने के साथ घटी । अतः यह अभिस्तावित किया जा सकता है कि हिमालयी चीड़ का अधिकतम अंकुरण प्राप्त करने के लिए बीज संग्रह में मध्यम आकार के शंकुओं को अधिक पसन्द किया जाना चाहिए।

References

Anon. (1948). Woody plant seed manual. USDA Forest Service, *Misc. Publ.* No. 654, 416 pp.

Anon. (1966). International rules for seed testing. I.S.T.A. *Proc. Int. Seed Assoc.* **31** : 1-152.

Anon. (1974). Seeds of woody plants in the United States. USDA Forest Service *USDA Hand Book* **450**, Washington D.C. 883 pp.

Djavanshir, K. and H. Pourbeik (1976). Germination value - a new formula. *Silva Genetica,* **25** : 79-83.

Eliason, E.J. and C.E. Heit (1940). The size of Scotch pine cones as related to seed size and yield. *Jour. Forestry,* **38** : 65-66.

Langdon, D.G. (1958). Cone and seed size of South Florida Slash pine and their effects on seedling size and survival. *Jour. Forestry* **56** : 122-127.

Maheshwari, P. and R.N. Konar (1971). *Pinus. Botanical Monograph* No. 7, CSIR New Delhi, 1-130.

Rafn, J. (1915). The testing of forest seeds during 25 years 1887-1912, 91 pp. Langkjaers Bogtrykkeri, Copenhagen (Cf. *USDA Agric. Handb.* **450**).

Read, A.D. (1932). Notes on Arizona pine and Apache pine. *J. For.* **30** : 1013-1014.

Sagwal, S.S. (1984). Studies on seed production from individual cones of chir pine (*Pinus roxburghii,* Sarjent). *Indian J. For.* **7** (1) : 4-6.

Singh, R.V., G.C. Gupta and K.C. Sharma (1970). Selection of chil seed stands in Himachal Pradesh. *Proc. Semi. cum Workshop on Genetic Improvement of Forest Tree Seed in India*, 175 pp.

Singh, Virendra (1986). Seed maturity and germination behaviour of Western Himalayan spruce seed. *D. Phil. Thesis,* Garhwal University, Srinagar, U.P.

.... (1989). Seed maturity indices in spruce. *Indian Forester,* **115** (5) : 342 - 347.

Snedecor, G.W. and W.G. Cochran (1967). *Statistical Methods,* 6th Edition, Oxford and IBH Publishing Co., New Delhi.

Troup, R.S. (1921). *The Silviculture of Indian Trees,* Vol. III, Clarendon Press, Oxford.

ROOT AND HEART ROTS IN *ACACIA MANGIUM* PLANTATIONS IN INDIA

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Introduction

Acacia mangium Willd. is a fast growing leguminous tree species native to North - eastern Australia, Papua New Guinea and Indonesia. It is valued for timber, veneer, particle boards, paper making and other purposes. It has been recently introduced in India and its large scale plantations are now being raised in West Bengal and southern states.

A review of literature shows that the exotic is susceptible to fungal diseases and decay. Heart rot in severe forms has been recently reported from Malaysia and Bangladesh. During surveys conducted in 1994, one of the authors (MDM) recorded Ganoderma root-rot and heart rot in young plantations of *A. mangium* in West Bengal, the former occurring widely and killing grown up trees outright whereas the latter, localised to wounds and branch stubs, does not appear to be of much consequence at present.

Materials and Methods

Decayed roots of *A. mangium* were collected along with the fruit bodies of the root-rot fungus from the affected areas in Midnapore Forest Division and examined in the laboratory. Isolations of the fungus were made from fruits bodies and decayed root on malt agar medium and cultural characteristics of the fungus were studied. Also some of the trees showing branch stubs and open wounds were felled at the site and cut portions of the stem showing heart rot were examined. Isolations of both white and brown rotters were made and their cultural characters of diagnostic value studied and compared with the original description of the fungus. Oxidase reaction was noted using malt extract agar medium supplemented with gallic and tannic acid.

Ganoderma Root-Rot: Monitoring of disease situation in planted stands of *A. mangium* in Arabari Research Range, under Midnapore Forest Division, West Bengal in January, 1995, revealed the presence of wide gaps and dead and dying trees particularly in Kusumdahari 1985 plantation where it was originally planted in lines at 2.5 meter spacing. In 1985 plantation, there were only 58 healthy trees, 6 trees had died and 9 trees were in the process of drying and dying due to root-rot. The wide gaps in the plantation were

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indicative of the dead and defective trees that had been removed earlier. Obviously, poor stock of trees in 1985 plantation has marred the chances of seed collection from the stand. Monitoring of the adjoining 1986 and 1987 plantations also revealed the presence of dead and dying trees. However, the number of affected trees was 8 out of the total number of 280 trees in 1986 stand whereas only 3 trees out of 160 were found dying in 1987 plantation. The dying trees showed yellowing of leaves followed by leaf shedding leaving the branches bare (Fig. 2). Ultimately the affected trees died over a protracted period. Examination of the root system exhibited rot in advance stages with characteristic white fibrous rot in sapwood and the presence of shiny laccate sporophores of the fungus at the base of the stem (Fig. 3) and in some cases they were also attached to the underlying infected roots. The pathogen was identified as *Ganoderma lucidum* (W. Curt.:Fr.) Karst. a common root pathogen of leguminous hosts in tropics. Further, the fungus, being a root inhabitant, had colonised the roots and its greyish white mycelial strands spreading on the surface of the root were quite distinct. As the disease is known to spread laterally though root contact, group mortality of trees was quite evident and this had resulted in wide gaps in 1985 plantation (Fig. 1). Similar large gaps in *A. mangium* plantations at Chandmura in the same Forest Range were also attributed to Ganoderma root-rot as the cut stumps of recently felled trees showed the presence of sporophores of the fungus. This was further confirmed by examining the specimens earlier collected by the Additional D.F.O. from the stand which showed the presence of sporophores of the fungus and decayed sapwood showing white fibrous rot. This was reportedly the oldest stand of *A. mangium* in Arabari Forest Range where almost 15 per cent of the total 50 trees had already been killed and removed from the planted stand (Table 1).

Dwindling of the stands both at Chandmura and Kusumdahari has been viewed with great concern, as the disease, if remains unchecked, is likely to wipe out the plantations over the years.

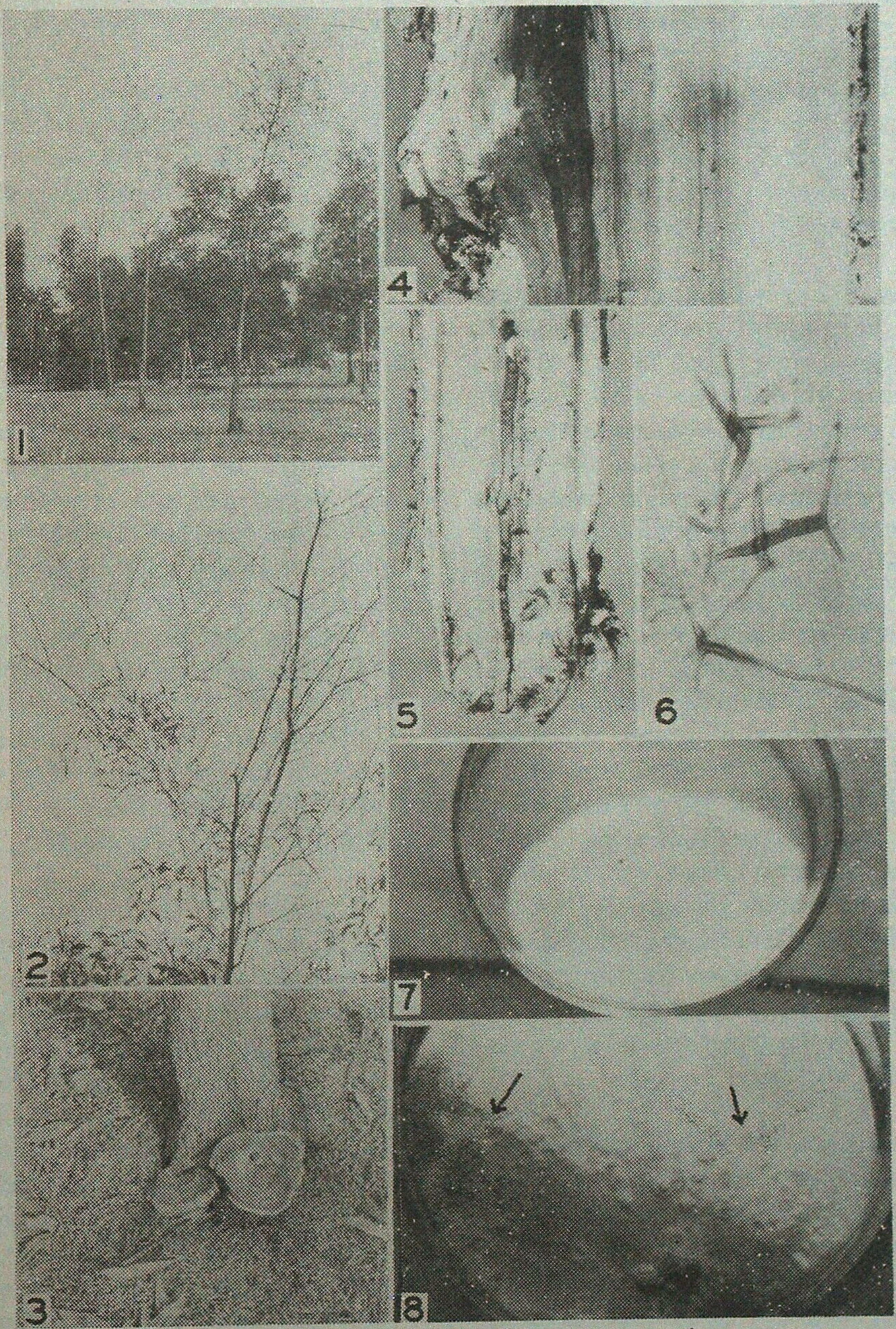
At Urami and Ghuchisole under Arabari Forest Range where *A. mangium* was recently planted over a large area in 1994, the disease was detected in 7-yr old *Cassia siamea* and *Albizia lebbek* trees which are also known to be susceptible to Ganoderma root-rot. The disease has earlier been detected on *A. mangium* and *A. auriculiformis* in the same forest range by Barari (1993). The presence of the fungus in different areas in Arabari Range clearly shows that the disease occurs widely and it

Table 1

Ganoderma root rot incidence in Acacia mangium plantations

Locality	Year of plantation	Total No. of trees assessed	Trees dead or dying due to root-rot	Percentage of dead or dying trees
Chandmura	1983-84	50	15	30
Kusumdhari	1985	73	15	20.5
-do-	1986	280	8	2.8
-do-	1987	160	3	1.8

Figs. 1-8



Root-rot and heart rots of *Acacia mangium*.

1. Mortality due to *Genoderma lucidum* showing large gaps in plantation. 2. Bare branches of an affected tree. 3. Sporophores of *G. lucidum* at the base of an affected tree. 4. Split trunk showing brown rot due to *Trametes palustris*. 5. Split trunk showing white fibrous rot due to *Phellinus pachyphloeus*. 6. Brown pointed sitae in six-week old culture of *P. pachyphloeus*. 7. Colony of *P. pachyphloeus* on malt agar medium. 8. Colony of *T. palustris* on malt agar medium showing fruiting structures.

has the potentiality to threaten the plantation of susceptible species if they are raised as pure crops. From the disease situation it is evident that *A. mangium* is highly susceptible to the disease and its plantations are likely to fail if continued to be raised in disease prone areas uncleared of the stumps and roots of the original crop.

In view of the seriousness of the disease situation it is imperative as the first step to check further spread of the disease to save the existing plantations. This can be achieved by isolating the diseased trees by digging isolation trenches of the size 0.3 m wide, 0.7 m deep and 1.8 m long across the line, one trenching immediately between the diseased tree and neighbouring apparently healthy tree and an additional trench between the apparently healthy tree and the next healthy tree on either side in the line. In future plantations, it is advisable to check the spread of disease when the trees are 5-6 yr old as beyond this age trench tends to become ineffective. Further, as the pathogen is widely distributed in Arabari Range, mechanised plantations by tractor ploughing the area before replanting is a sound proposition as it will not only help in removing the infected stumps and roots of the original crop but also add to vigorous growth of the stand due to better soil working.

Furthermore, it is advisable that the State Forest Department should now switch over from monoculture to mixed cropping to avert heavy mortality leading to failure of plantations, the possibility of which is very much there because of the disease currently ravaging the existing plantations. Use of teak, semul, gamhar, *Ailanthus*, eucalypts and other non-leguminous indigenous tree species being resistant to Ganoderma root rot should be planted along with *A. mangium* to break continuity of the exotic in the line in order to check lateral spread of the disease.

Heart Rots : Occurrence of heart rots has been recently recorded in *A. mangium* from Malaysia (Gibson, 1981; Lee and Zakaria, 1993) and Bangladesh (Basak, 1993). Out of 25 hymenomycetous fungi isolated from decayed wood in Malaysia, only one fungus *Phellinus noxius* is reported to have been identified. The problem of heart-rot in Bangladesh has been reported to be of serious nature though none of the hymenomycetous fungi associated have been identified. In India two fungi, one white rotter and the other brown rotter were found associated with heart rots in 1987 *A. mangium* plantations at Manbazar, under Purulia Forest Division and 1985-87 Arabari and 1985 Kusumdahari plantations in Midnapore Forest Division, West Bengal (Figs. 4 and 5). The fungi have been identified from the cultural characters as *Phellinus pachyphloeus* (Pat.) Pat. and *Trametes palustris* (Berk. ex Curt.) Murr. which are described as under.

The growth characters of both the fungi were studied for 6 weeks on malt agar medium at 25^{0}C. Radial growth of *P. pachyphloeus* moderately rapid, 2.5 cm in one week (Fig. 7) advancing zone white, the colour of mat changing from cream buff to ochraceous buff; extra cellular oxidase tests positive on gallic and tannic acid in malt agar media, hyphae thick-walled, unbranched, aseptate, setae dark brown with pointed tips, 28.6-57.2 μm x 4.2-5.7 μm (Fig. 6); radial growth of *Trametes palustris* moderately rapid, advancing zone even, mat white, short cottony becoming sub-felty after 4-6 weeks, pores develop at some places to form fruiting areas, (Fig. 8) basidiospores, hyaline, cylindric 5-8 x 2-3 μm; extra cellular oxidase test negative on malt agar medium

supplemented with gallic and tannic acid singly; hyphae of advancing zone, nodose-septate and branched. The cultural characteristics of both the isolates agree in all respects with those of authentic cultures of *P. pachyphloeus* and *T. palustris* originally described by Bakshi *et al.* (1969, 1970).

In West Bengal, where *Acacia mangium* plantations are only 7-10 yr old, heartrot, at present, is not a serious problem. However, if the species is raised on a long rotation basis for the purpose of timber, losses due to heart rot might be high because of the progressive nature of the decay. Since *P. pachyphloeus* and *T. palustris* are wound parasites and are known to enter the trees through injured surfaces and branch stubs, lopping should be avoided. While pruning, care should be taken to cut the low diameter branches close to the main bole for rapid healing and in case of large wounds creosoting may be done at the exposed surface to prevent establishment of decay fungi. Other predisposing factors responsible for heart rot should be worked out to employ silvicultural measures on stand basis to minimise losses.

SUMMARY

Root-rot of *Acacia mangium* by *Ganoderma lucidum* and heart rots by *Phellinus pachyphloeus* and *Trametes palustris* have been recorded from plantations raised in West Bengal. The exotic appears to be highly susceptible to Ganoderma root-rot which is quite prevalent in Midnapore Forest Division. Heavy mortality in 1985 plantation is viewed with concern by the State Forest Department. Effective measures to keep the disease in check have been outlined. Heart rots caused by *Phellinus pachyphloeus* and *Trametes palustris* are the first records of decay in standing trees of *A. mangium* in India. Though decay, at present, is not a serious problem it is likely to be highly damaging in older stands in view of the progressive nature of decay. Preventive measures for heart rots are recommended.

भारत के *अकेसिया मैंगियम* रोपवनों में जड़ों और सार काष्ठ का अपक्षयण

एम०डी० मेहरोत्रा, पी०सी० पांडे, ए० चक्रबर्ती, सुरेश शर्मा व के० हाजरा

सारांश

पश्चिम बंगाल मे उगाए हुए रोपवनों में *अकेसिया मैंगियम* को *गैनोडर्मा ल्यूसिडम* से जड़ों का अपक्षयण तथा *फेलिनस पैकिफ्लोएउस* व *ट्रेमेटेस पैलुस्ट्रिस* से सार अपक्षयण होता अभिलिखित किया गया है । यह परदेशीय पादप *गैनोडर्मा* से जड़ों के अपक्षयण के प्रति बहुत ज्यादा आक्राम्य प्रतीत होता है जो कि मिदनापुर वन मण्डल में बहुत फैला हुआ है । रोपवन में 1985 में हुए भारी वृक्ष मरण से राज्य वन विभाग को भारी चिन्ता हुई है । इस रोग की रोकथाम के प्रभावकारी उपायों की रूपरेखा बताई गई है । *फेलिनस पैकिफ्लोएउस* और *ट्रेमेटेस पैलुस्ट्रिस* से *अकेसिया मैंगियम* के खड़े वृक्षों में सार अपक्षयण होने का भारत से यह प्रथम उल्लेख है । यह अपक्षयण इस समय यद्यपि कोई गम्भीर समस्या नहीं है अपक्षयण की कृमिक बढ़ती गति को देखते हुए पुराने वृक्षों में यह अत्याधिक हानिप्रद भी बन सकता है । सार अपक्षयण के रोकथाम उपाय अभिस्तावित किए गए हैं ।

References

Bakshi, B.K., H.S. Sehgal and B. Singh (1969). Cultural diagnosis of Indian Polyporaceae. 1 - Genus *Polyporus. Indian For. Rec. (N.S.) Forest Pathology* **2** (9): 205-244.

Bakshi, B.K., Manjushri Sen and B. Singh (1970). Cultural diagnosis of Indian Polyporaceae 2 - Genus *Fomes* and *Trametes. Indian For. Rec (N.S.) Forest Pathology,* **2** (10): 245-276.

Barari, S. (1993). Attack of *Ganoderma* on *Acacia auriculiformis* and *Acacia mangium*. *Indian Forester*, **119** : 765.

Basak, A.C. (1993). *Official report on the heart rot of Acacia mangium Willd. in the plantation of Chittagong and Cox's Bazar Forest Division*, Bangladesh, Forest Research Institute, Chittagong, 9pp.

Gibson, I.A.S. (1981). Seed source establishment and tree improvement in Sabah, Malaysia. *Forest Mycology Consultants Report* No.3 FAO/UNDP-MAL/78/009, Rome 45pp.

Lee, S.S. and H.A. Zakaria (1993). Fungi associated with heart rot of *Acacia mangium* in Peninsula Malaysia. *J. Trop. For. Sci.* **5** : 479-484.

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TERMITE PROBLEMS IN ARID ZONES AND THEIR MANAGEMENT

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Introduction

The climatic, edaphic and demographic characteristics of the arid zones impose severe constraints which are often intensified by losses due to termite attack. While carrying out taxonomic studies on termites from Gujarat, Punjab, Haryana and some parts of Rajasthan, observations were also made on the termite infestations and the extent of damage caused. On the basis of these observations and in the light of available information in literature, the pest status of termites in arid zones are discussed here.

Faunal Composition

Roonwal and Bose (1964) reported 19 species of termites from Rajasthan. Subsequently, Roonwal and Verma (1977) raised it to 32, of which 27 species are from the arid areas of Rajasthan (Roonwal, 1976). The author carried out extensive surveys of the arid areas of Gujarat, Haryana, Punjab and some parts of Rajasthan (Thakur, 1985, 1988, 1989 a, b; Verma and Thakur, 1977), as a result of which thirty-five species of termites are now known from the arid zones (Table 1). Only 22 species are injurious to agriculture, horticulture and forestry and of these, the damage by the following species is rather serious : *Anacanthotermes macrocephalus, Heterotermes indicola, Coptotermes heimi, Odontotermes obesus* and *Microtermes obesi*. The pest status of these termites are discussed below :

(a) *Pests of Grasslands* (Pastures) : *Anacanthotermes macrocephalus* is an arid-zone species, considered as a serious pest of pastures and is endemic to arid areas of Gujarat and Rajasthan. Parihar (1978-1980) reported it as feeding on *Cenchrus ciliaris* and *Lasiurus sindicus* at Jodhpur. Thakur (1989b) reported it from many places in Kachchh (Gujarat), feeding on *Cenchrus setigerm. Trinervitermes biformis,* is another important foraging termite which causes extensive damage to pastures in arid zones. *Eremotermes paradoxalis* (Parihar, 1978, 1980) *Microcerotermes mycophagus* (Roonwal and Bose, 1964) have also been reported feeding on grasses in Rajasthan and Gujarat, though the losses caused by them are not very significant.

(b) *Pests of Agricultural and Vegetable Crops* : *Microcerotermes tenuignathus* (Parihar, 1978), *M. baluchistanicus* (Parihar, 1980) and *Microtermes obesi* (Thakur, 1985, 1988) are reported to damage wheat crops in Rajasthan, Gujarat and Haryana. The infestation occurs both at the germination and the growing stages of the crop. Verma *et al.* (1980) reported heavy damage to wheat crops at Hisar (Haryana) due to *M. obesi*. The *Bajra* crop was infested

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Table 1

Pest status of termites, their host plants and the nature of damage in arid zones.

Pest species	Areas	Host Plants	Authority	Nature of damage
1	2	3	4	5
Anacanshotermes marocephalus	Jodhpur and other areas of Rajasthan, Kachchh, (Gujarat).	*Cenchurus ciliaris*, *Lasiurus sindicus*, *Prosopis* sp., grasses, stored grains such as maize, wheat, etc.	Parihar, 1978, 1980; Roonwal and Bose, 1964, 1978; Thakur, 1989b.	Cuts grass, stems and leaves.
Psammotermes rajasthanicus	Barmer, Bikaner, Jaisalmer and Jodhpur (Rajasthan), Bhuj, Rann of Kachchh.	*Acacia* sp., *Calotropis procera*, *Dalbergia sissoo*, *Tecomella undulata*, *Tamarix* sp., *Zizyphus mauritiana*.	Parihar, 1978, 1980; Thakur, 1989; Verma and Thakur, 1977.	A minor wood destroying termite.
Heterotermes indicola	Bikaner, Jodhpur and other arid areas of Rajasthan; Mahendragarh (Haryana).	Damage wood-work in houses, rotten wood and dry trees, *Zizyphus mauritiana*, *Albizia* sp., Karela (*Momordica charantia*).	Roonwal, 1982; Roonwal & Bose, 1964, 1978; Roonwal and Verma, 1977; Thakur, 1988.	Nesting in wood, damage woodwork in houses. A major wood-destroying termite.
Coptotermes heimi	Jaisalmer, Jodhpur and other arid areas of Rajasthan, Bhuj (Gujarat), Bhatinda and Sangur (Punjab).	*Acacia senegal*, *Bamboo* sp., *Eucalyptus* sp., *Europhobia nivula*, *Ficus* sp., rotten tree trunk; damage woodwork (beams, doors, windows, furniture, etc.).	Roonwal and Bose, 1964; Thakur, 1982, 1984.	Attacks wood and some agricultural crops. A major wood-destroying termite.
Speculitermes cyclops	Bhatinda (Punjab)	-	Thakur, 1988.	Non-wood destroying termite.
Amitermes belli	Jodhpur (Rajasthan) and other arid areas of Rajasthan, Bhuj (Gujarat), Bhatinda (Punjab).	*Acacia* sp., *Anogeissus* sp., *Azadirachta indica*, *Bursera delpechiana*, *Eucalyptus* sp., *Morus alba*, *Dalbergia sissoo*, *Prosopis* sp., *Zizyphus mauritiana*, rotten tree trunk of trees.	Parihar, 1978, 1980; Roonwal and Bose, 1964, 1978; Roonwal and Verma, 1977; Thakur, 1982, 1984.	A minor wood-destroying termite.

Contd.....

1	2	3	4	5
Eremotermes fletcheri	Kachchh (Gujarat)	-	Thakur, 1989b.	-
Eremotermes neoparadoxalis	Jodhpur (Rajasthan)	-	Roonwal, 1976	A minor wood-destroying termite.
Eremotermes paradoxadis	Jodhpur (Rajasthan)	*Eragrotis paceides*, *Dichanthium annulatum*, and grasses.	Parihar, 1978, 1980.	-
Microcerotermes baluchistanicus	(Jodhpur (Rajasthan)	Guar crop (*Cyamopsis tetragonoloba*) and wheat crop.	Parihar, 1978, 1980.	-
Microcerotermes cameroni	Bhuj (Gujarat)	Dry roots of *Amaranthus spinosus*.	Thakur, 1980.	Attacks roots, stumps and trees logs and sleepters.
Microcerotermes heimi	The Rann of Kachchh (Gujarat)	Dry roots of Sieven grass (*Genchrus setigerus*)	Thakur, 1982.	A minor wood-destroying termite.
Microcerotermes laxmi	Bikaner (Rajasthan)	*Prosopis Juliflora.*	Roonwal and Bose, 1964.	-
Microcerotermes palestinensis	Bhuj (Gujarat)	Dry plants of unknown species.	Thakur, 1982.	-
Microcerotermes raja	Jodhpur (Rajasthan)	Palm stumps.	Roonwal and Bose, 1964.	-
Microcerotermes tenuignathus	Jodhpur (Rajasthan); Bhuj (Gujarat).	*Acacia* sp., *Acacia arabica*, *Albizia* sp., *Cyampsis tetragonoloba*, *Calotropis procera*, *Dalbergia sissoo*, *Morus alba*, *Pennisetum americanum*, *Prosopis* sp., *Sesamum indicum*, *Setaria italica*, *Triticum aestivum*, *Vigna radiata* and roots of bushes.	Parihar, 1978, 1980; Thakur, 1982, 1988.	A minor wood destroying termite.

Contd.....

1	2	3	4	5
Angulitermes jodhpurensis	Jodhpur (Rajasthan)	-	Roonwal & Verma, 1977.	Non wood-destroying
Odontotermes assmuthi	Kachchh (Gujarat), Ferozepur (Punjab)	-	Thakur, 1985, 1989b.	A minor wood-destroying termite.
Odontotermes bellahuniseusis	Jodhpur (Rajasthan), Kachchh (Gujarat) and Mahendragarh (Haryana)	*Acacia* sp., *Prosopis juliflora* and guar crops.	Parihar, 1979, 1980; Thakur, 1982, 1984; Verma & Joshi, 1984.	Attacks logs, dry stumps of trees.
Odontotermes brunneus	Jodhpur (Rajasthan), Kachchh (Gujarat), Hissar (Harayana)	*Dalbergia sissoo* and *Prosopis juliflora*	Parihar, 1978, 1980; Thakur, 1982; Verma and Thakur, 1977.	Attacking dry logs roots, and stem of living trees.
Odontotermes dehraduni	Jodhpur (Rajasthan)	-	Roonwal & Verma, 1977.	-
Odontotermes giriensis	Arid areas of Rajasthan; Ferozepur, Bhatinda (Punjab), Hissar, Mahendragarh (Haryana).	Often found in rotten wood lying on the ground.	Roonwal, 1976.	A minor wood-destroying termite.
Odonotermes girnarensis	Kachchh (Gujarat)	-	Thakur, 1989b.	-
Odontotermes gurdaspurensis	Jodhpur (Rajasthan); Ferozepur, Bhatinda, Sangrur (Punjab); Hissar, Mahendragarh (Haryana).	*Azadirachta indica*, *Eucalyptus* sp., *Eucalyptus camaldulensis*.	Parihar 1978, 1980; Verma and Thakur, 1977.	A minor wood destroying termite. Versatile species.
Odontotermes indicus	Sangrur (Punjab)	-	Thakur, 1988.	-
Odontotermes latiguloides	Jodhpur (Rajasthan); Bhatinda, Sangrur (Punjab); Mahendragarh (Haryana)	*Acacia tortilis*	Parihar 1978, 1980; Verma & Thakur, 1977.	-
Odontotermes lokanandi	Kachchh (Gujarat), Ferozepur, Bhatinda (Punjab); Mahendragarh (Haryana)	-	Thakur, 1988, 1989b.	-
Odontotermes microdentatus	Hissar (Haryana).	-	Thakur, 1988.	-

Contd.....

1	2	3	4	5
Odontotermes obesus	Jodhpur (Rajasthan), other arid areas of Rajasthan, Bhuj (Gujarat) and Mahendragarh (Haryana).	*Pennisetum hyphoides*, Chillies, grasses, *Delonix regia, Prosopis cineraria, Prosopia juliflora.*	Parihar, 1978, 1980; Sharma and Bohra, 1966; Thakur, 1982, 1984.	A major wood destroying termite. Versatile species.
Odontotermes sasangirensis	Kachchh (Gujarat)	-	Thakur, 1989b.	
Odontotermes paralatiguloides	Kachchh (Gujarat)	-	Thakur, 1989b.	
Odontotermes distans	Jodhpur (Rajasthan)	-	Roonwal & Verma, 1977.	A minor wood destroying termite.
Microtermes mycophagus	Barmer, Bikaner, Jaisalmer and Jodhpur (Rajasthan), Ferozepur, Bhatinda, Sangrur (Punjab); Mahendragarh (Haryana).	*Ricinus cummunis*, *Parkinsoni aculeata*, grasses, Bamboo, *Dalbergia sissoo*, *Euphorbia* sp., *Prosopis juliflora*, damage wooden door and ceiling wood, and other woodwork in houses.	Parihar, 1978, 1980; Roonwal and Bose, 1964.	A minor wood destroying termite. Attacks trees, agri. crops and wood work in houses.
Microtermes obesi	Bikaner and other arid areas of Rajasthan, Bhuj (Gujarat), Hissar (Haryana), Ferozepur, Bhatinda, Sangrur (Punjab).	Bajra, wheat, guar crops, *Acacia* sp., *Albizia lebbek*, *Prosopis juliflora* and bushes.	Parihar, 1978, 1980; Roonwal and Bose, 1964, 1978; Sharma and Bohra, 1966; Thakur, 1982; Verma, Khurana and Bhanot, 1980.	A major wood destroying termite. Attacks logs, dead tree stumps and agr. crops. A versatile species.
Microtermes unicolor	Bhatinda, Sangrur (Punjab); Mahendragarh (Haryana).	-	Thakur, 1988.	-
Trinervitermes biformis	Arid areas of Rajasthan; Bhuj (Gujarat) Ferozepur, Bhatinda, Sangrur (Punjab); Hissar (Haryana).	A serious pest of agricultural crops and fruit trees, feeds on grasses.	Roonwal, 1976. Thakur, 1982.	A minor wood destroying termite.

with *Odontotermes obesus* (Sharma and Bohra, 1966) and *M. obesi* (Sharma and Bohra, 1966; Roonwal and Bose, 1978) in arid areas of Rajasthan. Castor (*Ricinus communis*) was attacked by *Microtermes mycophagus*, both at the seedling and growing stages (Parihar, 1978). Guar (*Cyamopsis tetragonoloba*) is often infested by *Microcerotermes baluchistanicus*, *Odontotermes bellahunisnsis* and *Microtermes obesi*, at germination, flowering and fruiting stages (Parihar, 1978, 1980). Chilli is damaged by *Odontotermes obesus* and *Microtermes obesi* in arid areas of Rajasthan (Sharma and Bohra, 1966) and in Gujarat by *O. obesus* and *T. biformis*. Roonwal (1982) reported attack on germinating Karela *(Momordica charantia)* by *Heterotermes indicola*. Verma and Joshi (1984), reported damage to pearl millet *(Pennisetum americanum)*, foxtail millet *(Setaria italica)*, green gram *(Vigna radiata)* and cluster bean *(Cyamopsis tetragonoloba)* by *Microcerotermes tenuignathus*.

(c) *Pests of Forestry* : The termites cause heavy damage to forestry, particularly in the nurseries and young (1-3 years old) plantations. The termite problem is quite severe in the arid zones, particularly in dry seasons. Plant mortality at times is 80% or even more, sometimes resulting in total loss. The attack occurs below ground in the upper 20 cm of the soil layer. The bark of taproot is completely eaten up or ring basked, the damage further extending to collar region. Affected seedlings/young plants show signs of wilting, resulting in death. Similar damage occurs in case of stem cuttings where the underground woody portion gets decayed and attacked by subterranean termites. In the growing trees, the termites attack only the outer dead bark and is mostly restricted to the dead portions. Parihar (1981) reported that dead bark of almost all the trees attacked by termites in the semi arid and arid areas. The attack usually occurs under earthen runways or the mud plaster sheaths over the bark. The termite workers and soldiers travel to and fro from the ground connections, leading sometimes to the formation of carton nest among tree branches or inside the tree trunk. The workers thus eat away thin layers of the bark surface, but the damage caused is not much.

The following plant species are attacked by termites in arid zones: *Acacia tortilis (Odontotermes latiguloides)*, *Acacia senegal (C. heimi)*, *Acacia* sp. (*P. rajasthanicus, Microcerotermes tenuignathus, A. belli, O. bellahunisensis, M. mycophagus, M. obesi)*, *Albizia lebbek (H. indicola, M. obesi)*, *Albizia* sp. (*M. tenuignathus)*, *Anogeissus* sp. (*A. belli)*, *Amaranthus spinosus (M. cameroni)*, *Azadirachta indica (A. belli, O. gurdaspurensis)*, *Bombax ceiba (C. heimi)*, *Bursera deplechiana (A. belli)*, *Dalbergia sissoo (P. rajasthanicus, A. belli, M. tenuignathus, O. bellahunisensis, O. brunneus, M. mycophagus)*, *Delonix regia (O. obesus)*, *Dichanthium annulatum (E. paradoxalis)*, *Eragrostis paoeoides (E. paradoxalis)*, *Eucalyptus camaldulensis (O. gurdaspurensis)*, *Eucalyptus* sp. *(M. mycophagus, O. gurdaspurensis, Euphorbia nivula (C. heimi)*, *Ficus religiosa (C. heimi)*, *Morus alba (A. belli, M. tenuignathus)*, *Phoenix dactylifera (M. raja)*, *Prosopis cineraria (O. obesus)*, *Prosopis juliflora (M. laxmi, Odontotermes bellahunisensis, O. obesus, M. mycophagus, M. obesi)* *Prosopis* sp. *(A. macrocephalus, A. belli, M. tenuignathus)*, *Parkinsonia aculeata (M. mycophagus)*, *Sesamum indicum (M. tenuignathus,)*, *Tamarix* sp. *(Psammotermes rajasthanicus)*,

Tecomella undulata (*Psammotermes rajasthanicus*), *Zizyphus mauritiana* (*P. rajasthanicus, M. indicola, A. belli*), *Zizyphus* sp. (*A. belli*).

(d) *Pests of Fruit Trees* : *Anacanthotermes macrocephalus, Psammotermes rajasthanicus, H. indicola, A. belli, M. tenuignathus, O. obesus* and *Trinervitermes biformis* cause heavy loss to fruit in arid zones. Thakur (1985) reported damage to the bark and trunk of the mango trees (*Mangifera indica*) by *C. heimi, O. gurdaspurensis, O. obesus, M. mycophagus, M. obesi* and *T. biformis* in the Kachchh (Gujarat). Thakur (1988) collected *O. obesus* from a rotten stump of papaya plant at Hissar (Haryana). Ber (*Zizyphus mauritiana*) was infested with *Psammotermes rajasthanicus, H. indicola* and *A. belli* in arid areas of Rajasthan (Roonwal and Bose, 1964, 1978). Thakur (1989), reported *A. belli* and *M. tenuignathus* attacking the mulberry tree (*Morus alba*). Roonwal and Bose (1978) and Thakur (1989b) recorded infestations to citrus, guava, pomegranate and other fruit trees by termites in many places in Gujarat and Rajasthan. Thakur (1988) reported complete damage to the outer bark of *Ficus* sp. at Bhatinda (Punjab) by *Coptotermes heimi*.

(e) *Pests of Stored Grain, Timber etc.*: Termites also cause heavy damage to stored products such as paper, jute goods, textiles, cotton, tents, wooden articles, leather and rubber goods, food grains in storage, books, ordnance stores and other household goods. Roonwal and Bose (1978) reported damage to stored maize, wheat, etc. in arid areas of Rajasthan. Thakur (1985) recorded *H. indicola, O. bellahunisensis, O. obesus* and *M. obesi* causing heavy damage to wooden logs and other stored articles in the Kachchh region (Gujarat). *M. mycophagus* has been observed to destroy library books in Zoological Survey of India, Desert Regional Station, Jodhpur (personal observations).

(f) *Pests of Buildings* : Wood-work of buildings (beams, doors, windows, furniture, etc.,) is damaged by subterranean termites viz., *H. indicola, C. heimi* and *P. rajasthanicus* in arid areas of Rajasthan (Roonwal and Bose, 1978). Verma and Roonwal (1977) recorded *H. indicola* damaging wood-work in houses at Jodhpur (Rajasthan). Thakur (1988) observed complete destruction of a wooden almirah and other wood-work in the PWD Rest House by *C. heimi* at Mahendragarh (Haryana). Roonwal and Bose (1964) reported attack of *Microtermes mycophagus* on wooden door, ceiling wood and other wood-work in houses at Bikaner, Jaisalmer and Jodhpur (Rajasthan). Thakur (1985, 1989b) observed many houses in arid areas of Gujarat, Haryana and Punjab, infested with *H. indicola* and *M. obesi*.

Termite Control Measures

Chemical control of termites has been largely based on the use of chlorinated hydrocarobons (Aldrin, Dieldrin, BHC, Chlordance, Heptachlor, etc.) and organophosphorus insecticides (malathion, chloropyrifos, etc.) to a limited extent. Treatment can be given as follows :

(a) *For Control of Termites Injurious to Agricultural Crops* : Though the treatment may vary from crop to crop, the termite control in general, in agricultural crops can be carried out as follows :

(i) *Seed Treatment* : Gives protection during storage or at the nursery level from soil borne diseases and insect pests. In general, seed dressing may be done with 60 ml of

75% Lindane per 45 kg of seeds. This dose may be halved for aldrin, endrin or heptachlor.

(ii) *Soil Treatment* : With 1.25% DDT emulsion (150 litre/acre) before or after sowing or with 5% aldrin (9 kg/acre).

(iii) *Treatment of Standing Crop* : With 5% aldrin (12 kg/acre) gives effective protection.

(b) *For Control of Termites in Forestry and Horticulture* : (i) Spray 0.1-0.2% Aldrin 30 EC water suspension or choloropyrifos 20 EC or heptachlor 20 EC at the rate of 5-10 litres per sq. metre area. (ii) Mix 250 gm Ekalux granules or BHC dust with soil for a bed size of 1 x 10 m. (iii) For treatment of polypots, treat 2500 seedlings with 125 litres of 0.025% Aldrin or Heptachlor 20 EC. (iv) For older trees, scrap off the earthern encrustations made by termites on tree trunks and paint it with coal tar creosote or 0.1-0.2% aldrin or BHC or chlordance oil emulsion.

For Destruction of Termite Mounds : (i) Introduce in mounds 0.005% Gamma or 0.04% DDT suspension or 0.025% aldrin emulsion BHC at the rate of 9 litres per 10 ft^3 (0.283 m^3). It takes about a week for the complete killing of the entire colony. (ii) Put two tablets of aluminium phosphide in the mound and close the openings with wed mud. The termites die due to fumigant action.

(c) *Protection of Buildings* : (i) Foundation walls are treated when they have reached the ground level and before the trench in either side is filled in. The following insecticides are used in different parts of the world: Copper naptharate 5% in fuel oil at the rate of 2-4 litres per 100 ft^2 (9.29 m^2); sodium pentachlorophenate 2.5% in water, sodium arsenite 10% in water, DDT 8% in fuel oil, BHC 0.8% water emulsion at the rate of 5-9 litres per 100 ft^2 (9.29 m^2). For treatment to the levelled sites and prior to casting of slab floors-Dieldrin 0.3% in water emulsion. Two applications may be given (Sharma, 1974). (ii) For damage to the wood-work in buildings - the severely damaged portion of doors, windows etc. may be removed and burnt. If the damage is not much, remove the mud plasters with the help of cloth and paint it thoroughly with 6% ASCU (Copper-Chrome-Arsenic) solution or coal-tar creosote diluted up to 25 or 50% with fuel oil. (Pre and post constructional treatments are discussed in great detail by Roonwal, 1979).

(d) *Stored Timbers* : Spray 1% BHC solution at the rate of 3 litres per sq metre (Roonwal, 1979 and Sharma, 1974).

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SUMMARY

Termites cause heavy loss to agricultural crops, pastures, forest nurseries and young plantations, and are thus considered as great threat to the developmental programmes in the arid zones. Observations were made on the termite problems in arid areas of Gujarat, Punjab, Haryana and some parts of Rajasthan during 1979-85 and 1988-89. *Anacanthotermes macrocephalus, Coptotermes heimi, Odontotermes obesus* **and** *Microtermes obesi* **were recorded as serious pests of agriculture, forestry and horticulture, and** *Heterotermes indicola* **causes extensive damage to wood work in buildings. Pest status of these termites in arid zones is discussed.**

शुष्क क्षेत्रों में दीमक समस्याएँ और उनका प्रबन्ध

आर०के० ठाकुर

सारांश

दीमकें कृषि फसलों, चरागाहों, वन रोपणियों और नौउम्र रोपवनों को भारी हानि पहुँचाती हैं और इसीलिए शुष्क क्षेत्रों के विकास कार्यक्रमों के लिए भारी खतरा मानी जाती हैं । गुजरात, पंजाब, हरियाणा और राजस्थान के कुछ भागों में **1979-85** और **1988-89** के दौरान कुछ प्रेक्षण किए गए थे । कृषि वानिकी और बागवानी के लिए *एनेकैन्थोटर्मिस मेक्रोकेफालस, कोप्टोटर्मिस हाइमि, ओडोण्टोटर्मिस ओबेसस* और *बमाइक्रोटर्मिस ओबेसी* का गम्भीर नाशिकीट के रूप में अभिलेख हुआ है तथा *हेटेरोटर्मिस इंडिकोला* मकानों में लगी लकड़ियों को बहुत हानि पहुँचाती है । शुष्क क्षेत्रों में इन दीमकों को नाशि स्थिति का विवेचन किया गया है ।

References

Parihar, D.R.(1978). Field observations on the nature and extent of damage by Indian desert termites and their control. *Annals Arid Zone,* Jodhpur, **17** (2) :192-199.

........................(1980). Termite problems in desert plantations. *Annals Arid Zone*, Jodhpur, **19** (3) : 329-334.

........................(1981). Some observations in distribution and pest status of termites attacking forestry plantations in the Rajasthan desert. *Indian J. For.,* **4** : 22-25.

Roonwal, M.L. (1976). Field ecology and eco-biogeography of Rajasthan Termites: A study in Desert Environment. *Zool. Jahrb. (Syst.),* Berlin, **103** : 455-504.

........................(1979). *Termite and Termite Control in Tropical South Asia*. xii + 177 pp., Scientific Publishers, Jodhpur.

.... (1982). The termite, *Heterotermes indicola* as pest of the vegetable, Karela or bitter gourd (*Momordica charantia*), in the Indian desert. *Annals Arid Zone*, Jodhpur, **21** (3) : 131-135.

Roonwal, M.L. and G. Bose (1964). Termite fauna of Rajasthan, India. *Zoologica*, Stuttgart, **40** (3) : (Heft. 113) : vi + 58.

....(1978). Vegetational distribution of termites of Rajasthan (India) andtheir economic importance. *Proc. Indian Natnl. Sci. Acad.*, New Delhi, (B) **44** (5) : 320-329.

Roonwal, M.L. and S.C. Verma (1977). Resurvey of termite fauna of Rajasthan, India, and its zoogeography. *Rec. Zool. Surv. India*, Calcutta, **72** : 425-480.

Sharma, S.K. and O.P. Bohra (1966). Some observations on termite damage to agricultural crops in the arid region of Rajasthan. *Paper read at the Entomological Seminar*, Aligarh.

Sharma, V.P. (1974). Use of insecticides for pest management in forests. *Indian For. Bull.* No. 266: 1-53.

Thakur, R.K. (1985). An addition to the termite fauna of Thar Desert. *J. Bombay Nat. Hist. Soc.*, Bombay, **81** (2) : 496-497.

.... (1985). Pest status of termites in Gujarat, India. *Indian. J. For.*, Dehra Dun, **8** (1) : 37-40.

.... (1988). Termites from arid areas of Punjab and Haryana. *Rec. Zool. Surv. India*, Calcutta. Ms. 1-12 pp.

.... (1989a). Termite fauna of Gujarat (Insecta : Isoptera). *Indian For. Rec.*, Dehra Dun. **15** (1): 1-76.

.... (1989b). Field ecology, ecobiogeography and economic importance of Gujarat termites. *Indian For. Rec.*, Dehra Dun. (in press).

Verma, A.N., A.D. Khurana and J.P. Bhanot (1980). A new method of check termite damage in wheat crop. *Annals Arid Zone*, Jodhpur, **19** (4): 515-518.

Verma, S.C. and R.K. Thakur (1977). New distributional records of termites (Isoptera) from Jodhpur, Rajasthan, India. Newslet. *Zool. Surv. India*, Calcutta, **3** (1) : 14-16.

Verma, S.K. and N.L. Joshi (1984). Infestation by Microcerotermes tenuignathus Holmgren (Isoptera : Termitidae : Amitermitinae) in some Kharif crops. *Annals Arid Zone*, Jodhpur, **23** (2) : 131-133.

PHENOLOGY AND FORAL BIOLOGY OF *ACER CAESIUM* WALL.

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Introduction

The *Acer caesium* Wall. is a large deciduous tree, found growing in the Himalayan forests from 2,150 m to 2,600 m a.s.l., and fairly common in open places like grazing grounds. This zone experiences the temperate climate.

Pollen germination studies are essential for the estimation of the quantity of the pollen required for controlled pollination. Artificial germination of the pollen grains is a surest test of pollen fertility, which is important for undertaking any breeding programme. Similarly the extent of pollen viability is important specially in identifying the degree of compatibility. This information is lacking with regard to the Indian hardwoods as only few records are available. However, pollen germination and viability of six hardwoods i.e., *Juglans regia, Rhododendron arboreum, Pyrus pashia, Populus deltoides, Populus ciliata* and *Salix tetrasperma* had been undertaken by Khurana and Khosla (1969) and some other trees by Sharma (1984), Sharma and Gaur (1984), Gaur and Sharma (1985) and by some other workers time to time. Though the pistil provides the pollen with an environment which is most fit for pollen germination *in-vivo*, but certain growth regulators, particularly like boron, hormones, carbohydrates (sugars) are well known to have stimulating effect on pollen germination *in-vitro* also (Gaur and Sharma, 1985).

Materials and Methods

The present study was carried out on the isolated trees of *Acer caesium* at and around Nainital in Central Himalaya from Sher Ka Danda to Snow View (altitude between 2300 m to 2500 m). The phenological observations were made on the four phenophases, i.e., (1) leaf sprouting, (2) flowering and anthesis, (3) fruit setting, development and retention, and (4) leaf and fruit drop, during two successive years from March 1992 to March 1994. Two points of *Acer caesium* growth at similar elevation, stretching over 750 m, were established in two distinct micro-catchments. To explore the relation between the different phenophases and elevation, two sites in each micro-catchment were selected in both the elevations representing lower (S_1) and higher (S_2) limits of the *Acer caesium* growth with the catchments. The two sites were established so as to represent the whole array of variations in the temporal differentiation among the phenophases due to micro-climatic conditions. In each site twenty individuals of *Acer caesium* were randomly chosen for detailed data recording. The observations were made throughout

the year at 15 days interval (for broad phenological changes). A particular phenophase was considered to have started when about 10% of individuals were observed in that phase and was considered to have completed the phase when only less than 10% individuals remained in that particular phase.

The studies pertaining to floral biology were started from the very beginning of the bud stage of the flower. The twigs were marked for counting various floral stages at different time intervals. The flowering was recorded by counting the average floral stages on different twigs and 10 replicates in each case were taken. The formation of first floral bud was considered as floral initiation. 50% flowering was recorded when nearly 50% flowers had opened. Full bloom was taken as the stage when more than 90% flowers had opened.

Flowers for pollen collection were bagged at the preanthesis stage to prevent contamination with foreign pollen. The pollen germination studies were conducted in different concentrations of sucrose (10, 15, 20 and 25 per cent) and growth hormones (50, 100, 150 and 200 ppm of GA_3, IAA, Kinetin and Morphactin each) along with distilled water (control) at a temperature range between 4°C to 19.5°C. A pinch of boric acid was also added in each concentration for initiation of germination. Freshly dehisced pollen grains of the *Acer caesium* were taken and planted in requisite concentration of sugar/hormone following 'Hanging Drop Technique'. The progress of germination was observed in between 18 to 24 hrs and 40 to 48 hrs intervals, but the final count was taken after 48 hrs. The pollen viability was studied in 0.5% acetocarmine solution and the stainability was taken as an index for viability. Stained, filled grains were considered viable while non-stained, empty as non-viable.

For the fruit setting studies five trees of *Acer caesium* with two branches of each were tagged and observations were recorded after 20 days and 50 days of pollination. The average size, weight of the fruit and weight of the stone were recorded after full ripening of the fruits. The length and diameter of the fruits were calculated with the help of vernier's calliper. The average weight and size of the fruits was calculated on the basis of representative fruits.

Results and Discussion

(a) *Phenology* : On the basis of phenological observations on the *Acer caesium*, following Lawrence (1955); Opler *et al.* (1980); Ralhan *et al.* (1985) and Rawal *et al.* (1991), the various specified events in the phenophases can be summarized as following :

(1) *Leaf sprouting and development* : The leaf initiation in *Acer caesium* starts with the emergence of leaf buds in the last week of February. The site S_1 (lower altitude) starts sprouting a bit earlier. The synchronous leaf sprouting leads to the development of new leaves which is completed in both the sites by the 15th of April. The colour of the new leaves remains yellowish green till mid of May which then turns to dark green upto almost end of September. In October the colour of the leaves again turns to yellowish brown for being thrown during deciduous phenophase, which lasts for about 86 to 105 days.

(2) *Flowering and Anthesis* : The first floral bud was observed in the last week of February and the flowering was started from 10th of March on the lower altitude site (S_1) first and subsequently at the upper

altitude site (S_2). The flowering in higher altitude site occurred about 10 days later. The flowering starts simultaneously with leaf sprouting (Synantherous). The 50% flowering was noticed on 2nd April and full bloom on 12th April. The total period of flowering was 44 days (site S_2) to 48 days (site S_1). The duration and culmination of the flowering season was almost similar on both the sites.

The opening of the flowers started with a slit at the top of the bud, widened gradually and took 2-6 hrs for complete opening. The maximum anthesis of the flowers occurred between 12 noon to 2 p.m. (Table 1), when more than 25% to 40% of the total flowers had opened at both the sites. The morning and evening hrs of the day are not congenial for the anthesis. The anthesis percentage range of 11.11% to 26.66% of the total flowers marked was observed within a single day. The temperature range between 4.5°C to 20.5°C and R.H. 87% to 88.5% have been recorded during the anthesis (Table 1).

(3) *Fruit setting, development and retention*: The activity of fruit setting, fruit maturation and retention was observed as a longer phenophase in *Acer caesium*. A total of five tree individuals on both the sites were observed for the fruit setting observations with two branches of each at lower and higher elevation sites. The marked branches were tagged to observe the fruit setting behaviour of the tree in detail after 20 days and 50 days of pollination subsequently. The fruit setting starts in the last week of April. In the year 1993, 92.59% fruit setting occurred in a branch belonging to a tree of higher elevation site (S_2) after 20 days of pollination, whereas, in the year 1994, 96.0% fruit setting was observed in the another individual belonging to the same site, after 20 days of pollination. The percentage retention after 50 days of pollination had been observed as maximum 85.71% in a tree of higher elevation in 1993. The maximum retention after 50 days of pollination in a tree of lower elevation (S_1) in 1994 was 83.87% (Table 2). Thus an average fruit setting after 20 days of pollination was 86.86% on both the sites, whereas the fruit retention after 50 days of pollination has gone down with an average to 76.67% in 1993. Similarly the average fruit setting in the year 1994 was 88.84%, which has gone down to 75.96% after 50 days of pollination on both the sites (Table 2).

The fruits of *Acer caesium* are glabrate; nuts gibbous; wings 3.75 cm to 5.0 cm long, slightly divergent, or in some cases erect and overlapping at the inner edges; back somewhat curved. The fruit is two single seeded, winged halves still attached when shed so that the twisted wings are found. The long narrow seed is observed. The average weight of the fruits was 330 mg. The average size was (length 3.4 cm and diameter 2.8 cm). The average weight of the stone was 276 mg (without wings).

(4) *Leaf and Fruit drop* : In the first fortnight of the October the leaves turn to yellowish brown and leaf drop started from the end of October to first week of November. In December and January the tree remains leafless completely. During August the wings of the fruit become brown in colour and by the end of October the fruit dropping was started along with the leaves, which was completed upto mid of November. The trees of higher elevation (S_2) dropped their fruits and leaves nearly 10 days earlier, despite of the fact that the fruit maturation at higher elevation site (S_2) was delayed for about 10 days.

Table 1

Anthesis in Acer caesium: Statement on five successive days as well as the specific period within a day.

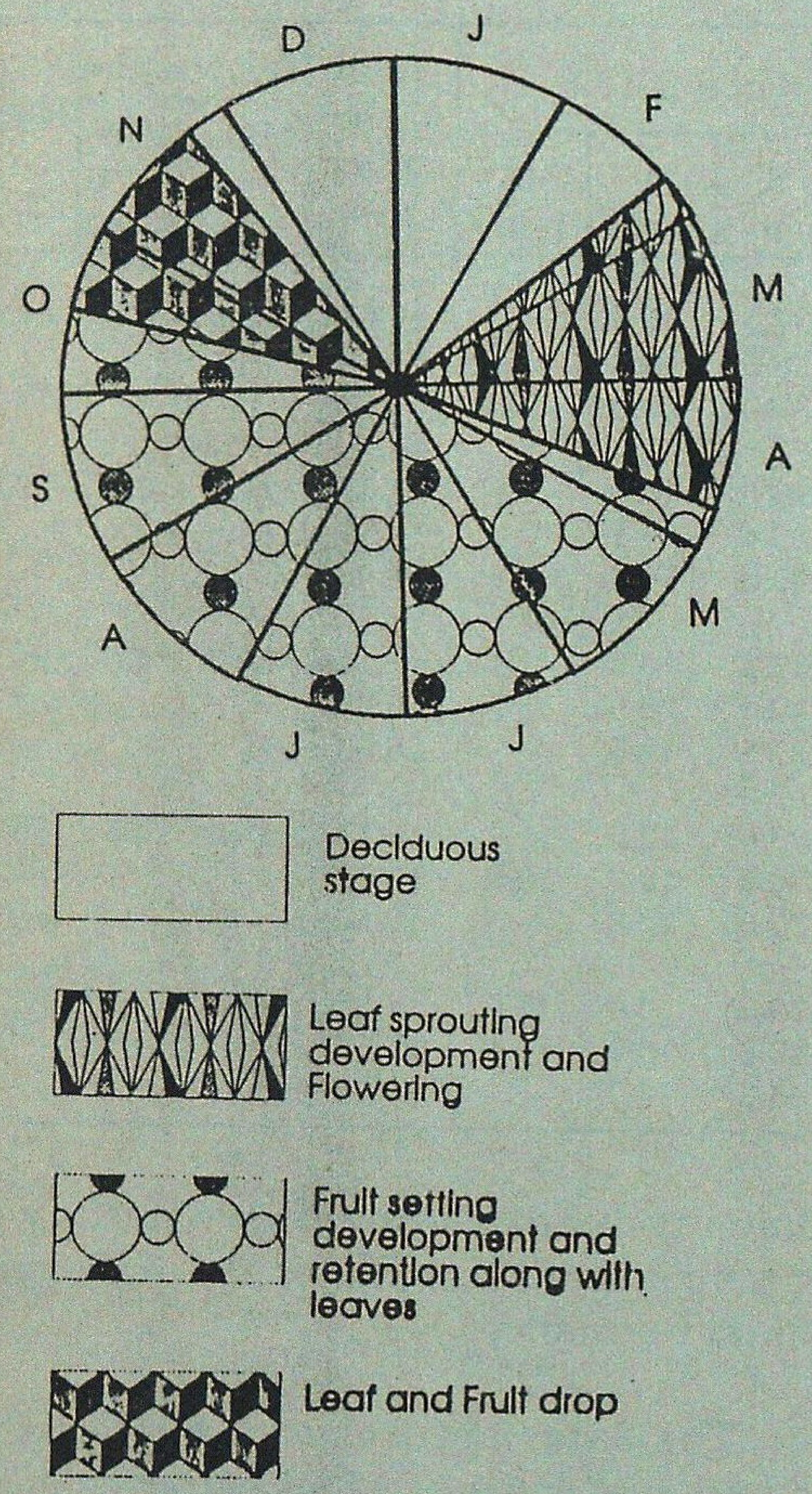
Date	Branch No.	No. of floral buds observed	Percentage of flowers opened at 6 a.m.	8 a.m.	10 a.m.	12 noon	2 p.m.	4 p.m.	6 p.m.	Total Anthesis (%)	Temperature Max.	Temperature Min	R.H. (%)
	I	42	-	-	12.5	25.0	37.5	25.0	-	19.04	20.0	5.0	87.0
22 March 94	II	38	-	14.3	14.3	28.6	28.6	14.3	-	18.42			
	III	47	-	10.0	20.0	20.0	30.0	20.0	-	21.27			
	I	63	-	14.3	14.3	28.6	28.6	14.3	-	11.11	20.5	5.0	87.0
23 March 94	II	68	-	09.1	18.2	27.3	36.4	09.1	-	16.17			
	III	40	10.0	10.0	20.0	20.0	30.0	10.0	-	25.00			
	I	35	-	-	16.7	33.3	33.3	16.7	-	17.14	20.5	4.5	88.5
24 March 94	II	26	-	-	20.0	20.0	40.0	20.0	-	19.23			
	III	30	-	12.5	12.5	25.0	37.5	12.5	-	26.66			
	I	44	-	12.5	25.0	25.0	25.0	12.5	-	18.18	19.0	4.5	88.5
25 March 94	II	62	-	10.0	20.0	20.0	30.0	10.0	10.0	16.12			
	III	54	-	11.1	11.1	22.2	33.3	22.2	-	16.66			
	I	56	10.0	10.0	10.0	10.0	30.0	10.0	10.0	17.85	19.0	4.5	88.5
26 March 94	II	36	-	-	10.0	30.0	40.0	10.0	10.0	27.77			
	III	32	-	-	16.7	33.3	33.3	16.7	-	18.75			

The statement of Wardle (1972) that "deciduousness is related to increasing winter severity" has been well established in the present study. The tree of *Acer caesium* remains leafless leading to dormancy during severe winter (November to February). At higher elevation site (S_2), late sprouting of leaves and floral buds including flowering due to micro-climate of the site, where climatic severity persists for relatively longer period may be responsible for the emporal variation in growth activity. The 10 days earlier fruit and leaf drop at higher elevation site (S_2) trees suggest increasing environmental severity over there. Thus decreasing temperature at higher elevation can be cited as a basic cause for this act. On the other hand at the commencement of summer season, higher atmospheric humidity due to melting of snow due to rise in temperature terminates the prolonged winter dormancy.

The late maturation and lengthy retention of fruits provides better chances for wind dispersal during early winters, when strong dry winds blow in the region.

The physical properties of soils in both the sites remained more or less same, which clearly shows that they do not have a direct bearing on the temporal differentiation of phenophases. Therefore, it is emphatically stressed that the phenological activities in *Acer caesium* are largely governed by the atmospheric temperature. The rise in temperature during early summers induced the growth, whereas the decline in

Fig. 1



Different Phenophases of *Acer caesium*

temperature in early winters terminated it. As a result of which leaf and fruit drop and dormancy is followed.

(b) *Floral Biology* : The flowers of *Acer caesium* are yellowish in cymosely branched terminal corymbs, appearing with leaves. Certain flowers in each cluster are male and others are female. The flowers near the tip remain sterile. The petals are small and cream coloured. Stamens short, but longer on male trees. The nectar cells are absent in the flowers. The Entamophillous type of pollination starts in the last week of March to early April.

Pollen germination and viability in-vitro : A pinch of boric acid initiated the germination of the pollen grains in each concentration. Distilled water (control) was also found to be an ideal source of pollen germination (Table 3). Maximum pollen germination (71.55%) was observed in lowest (10%) sucrose concentration has shown directly the decrease in germination percentage. In the growth hormones 150 ppm GA_3 (69.38%), 100 ppm of IAA (62.79%), and Morphactin (58.39%) were found to be comparatively suitable for the artificial germination of *Acer caesium* pollen grains *in-vitro* (Table 3).

The viability should be considered different from germinability of the pollen grains, for instance, self or cross incompatible pollen, though viable may or may not germinate on stigma. In an artificial medium, viable pollen may fail to germinate due to lack of certain essential factors. It is however necessary that viable pollen should give high percentage of germination for guessing the effective fertilization. In *Acer caesium* the pollen viability was observed as 75.36% by the Acetocarmine test.

It is therefore postulated that lower concentration of sucrose in admixture with 150 ppm of GA_3 and 100 ppm of IAA can be sprayed on the female flowers of the tree during the pollination and fertilization period (i.e., last week of March to early April) depending upon the maturation period) to enhance the germination percentage of the pollen grains on the stigma, if any breeding programme on *Acer caesium* has to be undertaken successfully.

Table 2

Fruit Setting Percentage in Acer caesium under open natural pollination in the years 1993 and 1994.

Site/ Plant No.	Branch No.	Year 1993		Year 1994	
		After 20 days of pollination	After 50 days of pollination	After 20 days of of pollination	After 50 days of pollination
$S_1/1$	I	87.50	75.00	88.46	80.76
	II	83.33	72.77	90.32	83.87
$S_1/2$	I	79.16	74.16	90.00	75.00
	II	89.65	79.31	88.88	72.22
$S_2/3$	I	90.96	72.72	78.26	69.56
	II	92.59	81.48	81.48	74.07
$S_2/4$	I	84.21	73.68	93.75	81.25
	II	88.23	82.35	96.00	72.00
$S_2/5$	I	82.60	69.56	90.47	71.42
	II	89.28	85.71	92.30	76.92
Average		86.86	76.67	88.84	75.96

Table 3

Percentage of pollen germination in Acer caesium under different concentrations of Hormones and Sucrose.

Hormones	After 24 hrs.				After 48 hrs.			
	50	100	150	200 (ppm)	50	100	150	200 (ppm)
GA_3	40.86	62.72	64.37	58.31	42.51	64.64	69.38	61.28
IAA	58.29	60.68	51.54	38.21	60.37	62.79	58.25	41.68
Kinetin	30.67	42.26	27.28	*	34.56	49.27	40.62	*
Morphactin	30.36	56.88	41.98	24.25	32.69	58.39	43.25	26.23
Sucrose	10%	15%	20%	25%	10%	15%	20%	25%
	70.33	68.25	62.98	56.37	71.55	69.93	64.88	60.35
Dil. water		53.33				58.44		

*Germination did not occur

SUMMARY

Phenology and floral biology of *Acer caesium* **Wall. from the Kumaun Central Himalaya were studied in relation to leaf sprouting, flowering and anthesis, fruit setting, development and retention and leaf and fruit drop along with its floral biology in relation to pollen germination and viability** *in-vitro*. **The emergence of new leaves starts in the last week of February along with the floral buds. The maximum anthesis occurs between 12 noon to 2 p.m. (upto 40%) at a temperature between 4.5°C to 20.5°C and RH, 87% to 88.5%. The total period of flowering for the species was 48 days. The average fruit setting percentage in** *Acer caesium* **had been recorded as 88.84% in the year 1994 after 20 days of pollination, whereas it remains only 75.96% after 50 days of pollination. The leaf drop and fruit drop starts in the month of October and the natural regeneration by the seeds takes place in the next**

monsoons. The highest percentage of pollen germination (71.55% in 10% sucrose and 69.38% in 150 ppm of GA_3 after 48 hrs of its culture) and viability (75.36%) reflacts the reproductive capacity and number of pollen grains required for controlled pollination studies in *Acer caesium* for undertaking any breeding programme.

एसेर केसियम वालि० की ऋतु जैविकी और पुष्पीय जैविकी

आर०के० सेमाल्टी व सी०एम० शर्मा

सारांश

कुमाऊँ केन्द्रीय हिमालय प्रदेश के *एसेर केसियम* वालि० की ऋतु जैविकी और पुष्पीय जैविकी का अध्ययन इसकी पत्तियाँ निकलने, पुष्प आने, फूल खिलने, फल बनने तथा काँच में पराग बनने और जीविष्णुता के संदर्भ में इसकी पुष्पीय जैविकी के साथ विकास और फल-पत्तियों के पेड़ पर ही लगे रहने तथा उनके गिरने का अध्ययन किया गया है । नई पत्तियों का आना पुष्पीय कलियों के साथ-साथ फरवरी के अन्तिम सप्ताह में आरंभ होता है । अधिकतम प्रफुल्लन 12 बजे दोपहर और 2 बजे अपराह्न के बीच (40%) 4.5° से 20.5° से० तापमान और आपेक्षिक नमी 87% और 88.5% के बीच होता है । इस वृक्ष जाति की कुल पुष्पन अवधि 48 दिन की है । *एसेर केसियम* में फल बैठने का औसत प्रतिशत 20 दिन तक परागण होने के बाद 1994 में 88.84% पाया गया जबकि 50 दिन तक परागण होने के बाद केवल 75.96% ही रह जाता है । पतझड़ और फलझड़ अक्टूबर मास में आरम्भ होता है और बीजों का प्राकृतिक पुनर्जनन अगली मानसून के बाद होता है । पराग बनने का अधिकतम प्रतिशत (71.55%) 10 प्रतिशत सुक्रोज और जीए$_3$ 150 भाग प्रति दस लाख भाग पानी मे मिलाकर कुछ घंटे के संवर्धन से 69.38% और जीविष्णुता (75.36%) होना प्रतिबिम्बित करता है ।

References

Gaur, R.D. and C.M. Sharma (1985). Morphology, viability and effect of Growth Regulators on the Germination and Tube growth of *Prunus cerasoides* D.Don. *Pollen. J. Tree Sci.,* **4** (1) : 30-33.

Khurana, D.K. and P.K. Khosla (1969). Pollen viability and germination studies in some hardwood species. *Ind. J. For.,* **2** (2) : 191-192.

Lawrence, G.H.M. (1955). *An Introduction to Plant Taxonomy.* Central Book Depot, Allahabad. 179 pp.

Opler, P.A., C.W. Frankie and H.G. Baker (1980). Comparative phenological studies of tree layer and shrub species in tropical wet and dry forests in the low lands of Costa Rica. *J. Ecol,* **68 :** 167-188.

Ralhan, P.K., R.K. Khanna, S.P. Singh and J.S. Singh (1985). Phenological characterstics of tree layer of Kumaun Himalayan forests. *Vegetatio.* **60 :** 91-101.

Rawal, R.S., N.S. Bankoti, S.S. Samant and Y.P.S. Pangtey (1991). Phenology of tree layer species from the timber line around Kumaun in Central Himalayn, India, *Vegetatio.* **93 :** 109-118.

Sharma, C.M. (1984). Flowering and Fruiting behaviour, *in-vitro* germination and viability of pollen grains of some commercial Peach cultivars. *Ind. Jour. Hort.* **41** (4) : 225-229.

Sharma, C.M. and R.D. Gaur (1984). Studies on Morphology, Germination and viability of Pomegranate *(Puncia granatum* L.) pollen. *Journal of Palynology,* **20** (2) : 87-92.

Wardle, P. (1972). An explanation for apline timber line. *NZ. J.Bot.* **9** : 371-402.

JATROPHA OIL - A PROMISING SOURCE OF EDIBLE OIL

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Introduction

Among the oil-seeds of forest origin, *Jatropha curcas* (Family : Euphorbiaceae), popularly known as ratanjyot, immense potential for producing Jatropha oil which finds large scale industrial uses. It is a large shrub, 3-4 m high which occurs almost throughout India and in Andaman Islands. In India, it flowers between September to December. The fruits mature two to four months after flowering, turning yellow when mature. It can be grown over a wide range of arid or semi-arid climatic conditions. A hot and humid climate helps in the early germination of seeds (Tewari, 1994). India has about 175 million hectares of wastelands which needs re-vegetation. *Jatropha curcas* is a well suited species as it is a wild growing hardy plant, well adapted to harsh conditions of soil and climate (Tewari, 1994; Diwakar, 1993).

The kernels (60 to 68% of seeds) are reported to contain 50 to 60% oil (38 to 40% on seed weight basis). The seeds contain some poisonous principles with purgative properties, rendering Jatropha oil unfit for human consumption (Tewari, 1994). Earlier it is reported that the seeds contain at least two toxic principles, one in the oil and another in the seed coat. One present in the oil has a necrotic action in small amount and is soon fatal to white mice (Heim and Rullier, 1919). A detailed chemical study of the oil was taken up to identify the toxic constituents and to evolve methods of refining the oil to edible grade. Findings of our preliminary investigations are reported in this communication.

Materials and Methods

Seeds of *Jatropha curcas* obtained from Agro Forestry Federation, Nasik (Maharashtra), were air dried and the seed coat was removed manually. A coarse powder of the kernels was extracted with pet. ether (60-80^0). The light yellow coloured oil obtained, was analysed for physico-chemical properties, using standard methods and the results are given in Table 1.

Table 1

Physico-chemical properties of Jatropha Oil

Property	Value
Kernel :	64%
Yield of oil (on Kernel wt. basis)	62.42%
Specific gravity at 29^{0}C	0.9110
Refractive index at 29^{0}C	1.4693
Acid value	3.72
Saponification value	193.8
Iodine value (Wij's Method)	98.1
Hydroxyl value	27.0
Unsaponifiable matter	0.45%

The oil was saponified and after removal of the unsaponifiable matter, the mixed fatty acids obtained were converted to their methyl esters by refluxing with methanol in the presence of concentrated sulphuric acid. The mixture of the methyl esters was analysed using a CIC Gas Chromatograph, fitted with FI detector and 15% diethylene glycol succinate (DEGS) on Chromosorb column (2m x 0.3 cm) at 190^{0}C, using nitrogen (50 ml/min) as the carrier gas. The peaks were identified by comparison of their retention times with those of reference compounds and by co-injection with authentic samples. The peaks area percentages were considered as weight percentages. The fatty acid composition of the oil is given in Table 2.

Table 2

Fatty acid composition of Jatropha Oil

Fatty acid	%
Palmitic	18.79
Palmitoleic	0.59
Stearic	4.42
Oleic	34.93
Linoleic	41.27

Acute toxicity studies of Jatropha curcas seed oil : Acute oral toxicity of *Jatropha curcas* seed oil (crude oil and refined/treated oil samples) was carried out, following standard methods. In one case *Jatropha curcas* seed oil was partitioned between pet. ether (60-80^{0}C) and methanol and the pet. ether soluble part of the oil was used. In second case, the seeds were boiled with water for one hr., filtered and dried. After extraction of the seeds with pet. ether (60-80^0), the crude oil recovered was used for the toxicity evaluation tests.

Randomly bred male albino rats of Wistar strain (120-160 g) were taken. They were acclimatized for 3-4 days in polypropylene cages on dust free rice husk in the laboratory environment, fed pellet diet (Lipton India Ltd.) and water adlibitum. The rats were divided into five groups of five animals each as shown below :

Group I - Control

Group II - Fed with ground nut oil (filtered grade) - 20g/kg

Group III - Fed with crude *Jatropha curcas* seed oil-20g/kg

Group IV - Fed with pet. ether soluble part of crude *Jatropha curcas* seed oil - 20g/kg.

Group V - Fed with crude *Jatropha curcas* seed oil, after boiling the seeds with water - 20g/kg.

Group II to Group V animals were fed the above mentioned oil samples, using oral feeding needle (the oils were delivered into the stomach). After feeding, the animals were observed for 14 days for Mortality, Gross changes in behaviour, Appearance of excreta/diarrhoea and Body weight gain.

Results and Discussion

Jatropha curcas seeds obtained from Nasik were found to contain 62.42% of oil (on Kernel wt. basis). The oil was pale yellow in colour and the physico-chemical properties of the oil, as reported in Table 1, are more or less the same as reported earlier (Holla *et al.*, 1993). Fatty acid Composition, as given in Table 2, reveals that the oil being rich in oleic and linoleic acids (34.93 and 41.27% resp.), contains palmitic acid (18.79%), palmitoleic acid (0.59%) and stearic acid (4.42%). The results resemble

Table 3

Percent body weight gain

Group	Days (post feeding)			
	1	2	7	14
Group I - Control	103.94 ±2.31	100.90 ±3.53	113.59 ±3.66	124.15 ±6.03
Group II - Fed with groundnut oil (filtered grade)- 20 g/kg (for comparison)	100.30 ±1.20	103.92 ±0.89	99.25 ±1.83	90.45 ±3.41
Group III - Fed with crude Jatropha seed oil - 20g/kg	93.72 ±1.73	87.70 ±3.13	97.30 ±0.79	113.93 ±3.95
Group IV - Fed with pet. ether soluble partof crude Jatropha oil - 20g/kg	100.78 ±0.73	106.45 ±0.81	109.32 ±0.93	121.31 ±0.86
Group V - Fed with crude Jatropha seed oil after boiling the seeds with water - 20 g/kg	97.68 ±0.83	84.67 ±2.52	97.91 ±2.69	107.25 ±3.18

Values are mean ± SEM of five animals

with results reported earlier (Holla *et al.*, 1993).

The results of toxicity evaluation are given bellow :

(i) Mortality : One rat died within 48 hours in Group III whereas no mortality was observed in all other groups.

(ii) Apparently no difference was observed in behavior of Jatropha oil fed animals compared to that of the control group or groundnut oil fed animals.

(iii) Difference was observed in the appearance of the excreta of Jatropha oil fed animals compared to that of groundnut oil fed animals. Jatropha oil fed rats showed semi solid/watery excreta upto 24 hours post feeding. However, the appearance of the excreta returned to normal after 24 hours compared to that of excreta of groundnut oil fed animals.

(iv) The trend of body weight gain (% change) is given in Table 3.

Conclusion

The studies being carried out on Jatropha oil may prove that it may be used for edible purposes if a methodology is worked out to remove constituents responsible for inducing purging.

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SUMMARY

The toxicological studies, as given in the present paper, have revealed that no mortality of test animals was observed with refined/treated oil samples. However, sub-acute toxicity study, following oral route of the oil samples, may be required to arrive at fine conclusion. The preliminary studies, as given in the present paper, indicate that *Jatropha curcas* seed oil can be helpful in solving the problem of shortage of edible oils in the country, to some extent if a methodology is worked out to remove constituents responsible for inducing purging.

जात्रोफा तेल - खाद्य तेलों का उत्साहप्रद स्रोत

पी०पी० जैन व सुषमा महाजन

सारांश

प्रस्तुत अभिपत्र में दिए गए विषाक्तता परीक्षणों से पता चलता है कि इस तेल के शुद्ध किए (उपचारित) नमूनों से किसी परीक्षित पशु की मृत्यु होती नहीं पाई गई । तथापि तेल नमूनों को मुँह से खिलाने पर हुई थोड़ी विषाक्तता के कुछ और अध्ययनों के बाद ही अन्तिम निष्कर्षों पर पहुँचा जा सकता है । इस अभिपत्र में दिए गए प्रारम्भिक अध्ययन बताते हैं कि *जात्रोफा कुर्कास* के बीजों का तेल देश की खाद्य - तेलों की कमी की समस्या को कुछ सीमा तक सुलझाने में सहायता दे सकता है यदि इसके उपविकट रेचन प्रेरित करने वाले संयोगांगों को इसमें से निकालने के लिए रीति विज्ञान को विकसित किया जा सके ।

References

Tewari, D.N. (1994). *Brochure on Jatropha,* ICFRE, Dehra Dun.

Diwakar, V.J.M. (1993). Energy from the humble castor. *The Indian Express,* 16th Nov.

Heim, F. and Rullier (1919). The toxic principles of the seed and oil of the physic - nut tree (*Jatropha curcas L.), Bull. del office Colonial, 12,* 96-110, *Bull. Agr. Intell,* **10** 653.

Holla, K.S., R.H. Millwalla, A.D. Shitole and N.S. Rajan Sunder (1993). Tallow substitute from ratanjyot oil (*Jatropha curcas), J. Oil Technol. Assocn.* of India, **25** (4) : 75.

Raina, Ashok K. and B.R. Gaikwad (1987). Chemobotany of Jatropha species in India and further characterisation of curcas oil, *J. Oil Technol. Assocn.* of India, **19** (4) : 81.

RESEARCH NOTES

(I)

STUDIES ON THE SEASONAL VARIATION IN NUTRITIVE VALUE OF *GMELINA ARBOREA* LINN.

Introduction

Gmelina arborea is an indigenous fodder tree distributed throughout India, except very dry regions of Rajasthan and Gujarat and temperate Himalayas. It is also found in moist regions of Sri Lanka upto 1500 m. The tree grows in subtropical and tropical climate, and on a wide variety of soils, but attains good growth on fertile, sandy loam soil in moist valleys (Rodger, 1913). It is fast growing tree and attains a height upto 2.42 m and girth 28.6 cm respectively in 40 years (Homfray, 1937). The foliage of the tree is considered as good fodder (Laurie, 1945; Anon., 1947).

Most of the work on *Gmelina arborea* was done on nutritional aspects and there is a paucity of information regarding suitable period of lopping the leaves of *Gmelina* to obtain maximum nutrients to feed the livestock. The present investigation delineates the variation of nutritive value of *Gmelina* as influenced by seasons.

Materials and Methods

Gmelina arborea tree was selected at forest area, near Mettupalayam (Coimbatore District, Tamil Nadu). The leaf samples of the tree were collected from six seasons viz., April-May (hot summer), June-July (summer), August-September (pre-monsoon) October-November (monsoon), December-January (winter) and February-March (post-winter) In each season, the leaf samples were collected from the third side branch from the main terminal branch.

Dry matter was estimated and a portion of sample was chopped, dried in hot air oven at 65^{0}C, ground and analysed for crude protein (Humphries, 1956), ether extract crude fibre, total ash, organic matter (Anon., 1970), nitrogen free extract (Singh and Pradhan, 1981) and total carbohydrate (Dubois *et al.,* 1956). The procedure of sampling and chemical analysis was reported every two months throughout the year from May, 1990 to March, 1991.

Results and Discussions

The average bimonthly nutritive value of *Gmelina arborea* is shown in Table 1. Perusal of Table 1 revealed that dry matter content was highest during monsoon season November (35.06 per cent) and lowest during (post-winter) March (33.60 per cent). Momin and Ray (1943) also reported highest dry matter content in *Bambusa indica, Eugenia jambolana, Ficus infectoria* and *F. religiosa* during October-November.

Among the six periods studied, maximum crude protein was recorded during May (15.16 per cent) and minimum crude protein was observed in Winter season January (12.45 per cent). Akkasaeng *et al.,* 1989 also reported maximum crude protein content in the tree during May. In the

Table 1

Seasonal variation in nutritive value of Gmelina arborea (per cent)

Season	Dry matter	Crude protein	Ether contract	Crude fibre	Total ash	Organic matter	Nitrogen free extract	Total carbo-hydrate
May	33.76	15.16	3.25	22.60	5.81	94.20	53.18	39.75
July	33.94	14.71	3.13	24.61	6.73	93.27	50.84	42.75
September	34.11	14.06	2.63	23.00	8.24	91.76	52.09	44.00
November	35.06	13.33	2.50	22.22	6.15	93.85	55.81	46.50
January	34.60	12.45	3.63	21.88	5.21	94.79	56.84	48.75
March	33.60	14.70	3.50	21.61	5.48	94.53	54.71	37.88
SEd	1.74	0.16	0.13	0.11	0.04	0.04	0.27	0.32
CD	3.72	0.36	0.28	0.24	0.08	0.09	0.57	0.68

present study highest ether extract (3.63 per cent) was recorded in January (winter) and lowest (2.50 per cent) was recorded in November (monsoon). It is evident that *Ficus religiosa* and *Prosopis spicigera* had highest ether extract during winter season (Patel and Patel, 1957; Gupta and Mathur, 1974).

In the present study maximum crude fibre content (24.61 per cent) was recorded during July (summer) and minimum (21.61 per cent) was recorded in March (post winter). This has been supported by Kaushal *et al.* (1986) in *Robinia pseudoacacia*.

September (pre-monsoon) appeared to be the best month for maximum total ash content (8.24 per cent) and least (5.21 per cent) was observed in January (winter). But Akkasaeng *et al.* (1989) reported maximum total ash content was during May.

In the present analysis highest organic matter content (94.79 per cent) was observed in January (winter) and minimum (91.76 pet cent) was in September (pre-monsoon). Maximum nitrogen free extract (56.84 per cent) was observed during January (winter) and minimum (50.84 per cent) was in July (summer). Mittal *et al.* (1989) also supported that maximum nitrogen free extract was in *Bauhinia retusa, Celtis australis, C. eriocarpa, Gremia oppositifolia* and *Quercus incana* during winter season. It has been analysed in the present study that highest total carbohydrate (48.75 per cent) was recorded during January (winter) and lowest (37.88 per cent) during March (post-winter).

References

Akkasaeng, R., R.C. Gutteridge and M. Wanapat (1989). *Evaluation of trees and shrubs for forage and fuelwood in Northwest Thailand.* Faculty of Agril. Khonkaen University, Khon Kaen, Thailand.

Anon. (1947). The use and misuse of shrubs and trees as fodder. *Joint publication. No. 10.* Imp. Bur. pastures and field crops, Imperial Agricultural Bureaux, Aberystwyth.

.... (1970). *Official methods of analysis*. Association of Official Agricultural Chemists, Washington (11th edition).

Dubois, M., K.A. Gilles, J.K. Hamitton, P.A. Rebers and F. Smith (1956). Colorimeter method for determination of sugars and related substances. *Anal. Chem.* **28** : 250-352.

Gupta, M.C. and C.S. Mathur (1974). Studies on the seasonal variation in the chemical composition of Khejri (*Prosopis spicigera). Indian Forester,* **100** : 269-273.

Homfray, C.K. (1937). *Nursery and plantation notes for Bengal* (14th edition) Forest Department, Supdt. Govt-printing, Alipore, Bengal, 210 p.

Humphries, E.C. (1956). *Mineral components and ash analysis Modern methods of plant analysis.* Springer-verlag, Berlin, pp. 468-502.

Kanshal, A.N., Javed Rattan and S.D. Bhardwat (1986). Effect of locality tree size, and season on nutrient content of *Robinia pseudocacacia. J. Tree Sci.,* **45** : 43-45.

Laurie, M.V. (1945). Fodder trees in India. *Indian For. Leafl.,* 82 (Silvi), F.R.I. Dehra Dun, 17p.

Mittal, G.K., K.M. Sharma, M.L. Maheswari and C.S. Barsaul (1989). Chemical composition of tree leaves during different season in Chakarata (Dehra Dun) hill area of Uttar Pradesh. *Indian Vet. J.* **66** : 246-248.

Monin, S.A. and S.C. Ray (1943). Tree leaves as cattle fodder. The seasonal variation in the composition of some edible tree leaves. *Indian J. Vet Sci.,* **13 :** 183-190.

Patel. B.M. and P.S. Patel (1957). Fodder value of tree and vegetable leaves in Kaira District. *Indian J. Agric. Sci.* **27** : 305-307.

Singh, Randhir and K. Pradhan (1981). *Forage Evaluation.* Allied Publications. (P) Ltd., Madras.

Rodger, A. (1913), Notes on gumhar (*Gmelina arborea* Roxb.). *For. Bull.* **16**, Supdt. Govt. Printing, Calcutta, p 10.

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Snippets WORKSHOP

International Workshop on *Hypsipyla* Shoot Borers of Meliaceae
20th to 23rd August 1996, Kandy, Sri Lanka

Hypsipyla spp. are the overriding factor limiting establishment of plantations of mahogany, red cedar and other species of Meliaceae. The workshop will review the biology and management of *Hypsipyla*, and identify potential control methods and priority areas for future research. Contact : Caroline Hauxwell, Department of Zoology, University of Oxford, South Parks Rd, Oxford, UK. Fax : 44-(0)1865 310447, Phone 44-(0) 1865 271124.

(II)

GINKGO BILOBA LINN. - A LIVING PLANT FOSSIL OF JURASSIC PERIOD

The Ginkgo (*Ginkgo biloba* L.) is a relic group, a link to no other living plant and is considered to have been derived from other now extinct ancestors. The ginkgo is clearly a gymnosperm but it without any near relatives in the group. The Ginkgoaceae family is believed to have been represented by other genera when at its zenith, probably in the early Jurassic period.

A monotypic genus represented by *G. biloba* Linn. (Maidenhair tree) not known in the wild, has long been cultivated in Chinese temple garden and Japan where the tree is considered sacred. It was introduced in Europe in about 1730 and this country in 1784. Trees are desirable for ornamental as avenue where they are tolerant of smoke and low water supply.

On account of recorded details it is so far reported from Govt. House, Nainital. Authors have examined the specimen which is collected from Kalika, Ranikhet (2000 m), Distt. Almora (Kumaun Himalaya) lies between 29^0-36^0N latitude and 79^0-81^0E longitude. A much branched dioecious deciduous hardy tree growing to 90 feet high; true vessel absent in the secondary wood, resin ducts present; leaves alternate; flagellate, often bifid dichotomously veined; staminate trees with stamen in pair in a catkin like bractless strobilus borne in leaf axils and bearing usually 2 anthers (microsporangia) on each stalk (Sporophyll), embryo with two cotyledons.

Numerous horticultural varieties of *G. biloba* L. are known, some of them with variegated or fringed leaves. The tree is propagated by seeds or by cuttings or grafting. It grows very slowly, even the cuttings taking about 2 years to root.

We conclude with the emphasis that the taxon deserves recognition and requires proper management to conserve the rare living fossil of the Jurassic period.

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(III)

FUNGICIDAL EFFECT ON GERMINATION OF *BUTEA MONOSPERMA* SEEDS DURING STORAGE

Introduction

Butea monosperma (Lam.) Taub. is a medium tree of papilionaceae. It regenerates efficiently through root suckers and survive well in degraded forest. Also its growth on buds of paddy fields do not adversely affect rice yield. It is a good host for lac insects and thus produces huge quantity of lac every year. The dye obtained from the lac and flowers is used as colouring agents. The leaves serve the purpose of cups and plates and also as fodder. Fibres from the root suckers are used in making ropes. Although the wood is used to some extent as firewood, it has little values as timber. This seems to be the main reason that farmers maintain it on paddy field bunds. Seeds of this species are oily and proteinaceous due to which damage by large number of fungi during storage takes place. In the present investigation an attempt has been made to study the role of different fungicides on seed germinability of *Butea monosperma* during storage. Earlier workers (Chandra and Sharma, 1975; Munjal and Sharma, 1977; Jamaluddin *et al.*, 1983) have already emphasized the importance of fungicidal treatment in seeds of forestry tree species.

Materials and Methods

Pods of *Butea monosperma* were collected from the campus of Tropical Forest Research Institute, Jabalpur during May, 1993. Pods were beaten with the help of stone to extract the seeds. After proper sun drying, four hundred seeds were taken for germination. Petri plates containing moistened blotter paper were kept in seed germinator at $30^0 \pm 2^0$C. The other lot of 400 seeds was also allowed to germinate in buckets containing soil mixture (soil, sand and cow-dung 1:1:1) and irrigated with tap water once-a-day. Five fungicides viz. Dithane M-45 (Manganeseethyilenebis-dithiocarbasat plus Zink), Bavistin (Methyl - 1H - benzimidazole - 2-yl carbomate), Fytolan (Copper oxy chloride), Caresan (Phenyl mercuric acetate) and Thyride (Tetramethyl thiuram disulfide) were used for seed dressing at 0.1% concentration. The fungicides were applied by through mixing with the seeds in capped plastic boxes separately to give an uniform coating. The equal quantity of untreated seeds served as the control. Treated and untreated seeds kept in polythene bags separately at root temperature upto 12 months for storage. The seed germination of treated and untreated seed were recorded simultaneously after 48 hours and 4, 8 and 12 months of storage. Observation were taken regularly at a fixed time upto completion of germination.

Results and Discussion

Seed germination was 100 per cent in treated as well as in untreated seeds in both the substrata i.e. blotter paper and soil mixture when tested after 48 hours of treatment. Percentage of seed germination was gradually decreased in treated and untreated seed lot along with germination period but it was always higher on the

Table 1

Percentage germination of B. monosperma seeds treated with different fungicides (0.1%) in different storage period

Fungicides	Periods of storage after treatment with different fungicides							
	48 hrs		4 months		8 months		12 months	
	BP	SM	BP	SM	BP	SM	BP	SM
Bavistin	100	100	100	98	92	86	82	78
Dithane M-45	100	100	100	100	96	92	86	82
Thyride	100	100	98	94	94	88	86	80
Fytolan	100	100	90	84	80	76	70	68
Ceresan	100	100	98	92	90	86	80	78
Control	100	100	100	86	88	72	78	64

Note : BP = Blotter paper, SM = Soil mixture

blotter paper (Table 1). Gradual reduction in germination percentage during storage may be due to the fact that moisture content and temperature in polythene bags were favourable to fungal growth resulting in seed deterioration. However, germination percentage was comparatively less in soil mixture as compared with the blotter test due to fluctuation of moisture content, temperature and aeration coupled with microbial activities. Dabral (1976). Munjal and Sharma (1977) and Jamaluddin *et al.* (1985) found that fungicidal treatment enhanced the seed germination by controlling the seed mycoflora.

References

Chandra, J.P. and R.K. Sharma (1975). Effect of fungicides on germination and survival of chir pine seedlings)*Pinus roxburghii* Sargent). *Indian Forester,* **101** (8) : 441-447.

Dabral, S.L. (1976). Extraction of teak seeds from fruit their storage and germination. *Indian Forester,* **102** (10) : 650-658.

Munjal, R.L. and A.D. Sharma (1977). Control of seed mycoflora of some important conifers. *Indian Jour. Mycol. Pl. Pathol.,* **6** (2) : 135-139.

Jamaluddin, V.S. Dadwal and K.K. Soni (1983). Studies on pod rot of *Pongamia pinnata* and its control. *Indian Jour. For.,* **6** (4) : 287-288.

.... (1985). Fungicidal effect on mycoflora and oil contents of Sal (*Shorea robusta*) and Karanj (*Pongamia pinnata*) seed during storage. *Seed Res.* **13** (2) : 64-66.

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(IV)

THE GENUS *OXYTENANTHERA* IN ASIA

The genus *Oxytenanthera* was proposed by Munro in 1868 in his monograph of the Bambuseae. He included a total of 5 species under this genus. Holttum (1956) while discussing the importance of ovary structure in bamboo systematics, pointed out that the genus *Oxytenanthera* has a typical ovary structure present only in the African species *O. abyssinica* (A. Rich.) Munro (type species) and as such the rest of Asiatic species placed under this genus should be removed from the genus *Oxytenanthera*. He also suggested that these belong either to *Gigantochloa* or *Dendrocalamus*. This view was supported by Clayton and Renvoize (1986) and Widjaja (1987). Soderstrom and Ellis (1988) in their account of Bamboos of Sri Lanka, transferred *Oxytenanthera monadelpha*, the only species of this genus found in Sri Lanka, to a new genus *Pseudoxytenanthera*, which they believed as monotypic. Majumdar (1989) in his enumeration of Indian bamboos independently came to the conclusion that Indian species of *Oxytenanthera* differ from the original generic concept and he treated these under a few genus *Pseudotenanthera* (on the basis of similar characters as used by Soderstrom and Ellis (l.c.) for proposing the genus *Pseudoxytenanthera*) with *Oxytenanthera monadelpha* as the type species. He treated a total of 5 species under this genus. Naithani (1990) suggested that the name *Pseudotenanthera* Majumdar was a superfluous name, treating it as a synonym of *Pseudoxytenanthera* Soderstrom and Ellis. Naithani (l.c.) also made some new combinations transferring the species included by Majumdar under *Pseudotenanthera* to *Pseudoxytenanthera*.

Thus, we see that the systematic position of Asian species of *Oxytenanthera* has been in a state of great confusion. The various species were removed from the generic limits of *Oxytenanthera* only because Holttum (1956) suggested that the genus *Oxytenanthera* was monotypic based on its typical ovary structure, which was present in only *O. abyssinica*. However, Holttum (1972, c.f Grosser and Liese, 1973) later pointed out that his assessment of the distinctiveness of the ovary character of *O. abyssinica* was possible wrong and these observations need a re-analysis. Hence, the basis of excluding Asiatic species of *Oxytenanthera* from the genus has lost ground. Whereas the transfer of *O. Monoadelpha* under a new genus *Pseudotenanthera* seems reasonable due to its possession of certain unique characters (Soderstrom and Ellis, 1988), the transfer of remaining species of *Oxytenanthera* under the genus *pseudoxytenanthera* is not justified. As also suggested by Soderstrom and Ellis (l.c.) the genus *Pseudoxytenanthera*, as at present, is monotypic since the typical branching pattern exhibited by *P.monoadelpha* is not shared by any other Asiatic species of *Oxytenanthera*. It may be added that Grosser and Liese (1973) while emphasizing the importance of structure of vascular bundles of the culms in the classification of bamboos, observed a similar type of vasculature in *O.*

abyssinica, O. albo-ciliata and *O. howsensii.* Pattanath and Ramesh Rao (1969) also reported a similar vascular bundle structure for *O. abyssinica* and *O. albo-ciliata*. According to Grosser and Liese (l.c.), at least some species of *Oxytenanthera* growing in Asia possess an anatomical structure closely related to *O. abyssinica*. Keeping these facts in mind, the various Asiatic species of *Oxytenanthera* should be kept under this genus only until some more information becomes available about their morphology and also about the generic limits of *Gigantochloa* and *Dendrocalamus*.

References

Clayton, W.D. and S.A. Renvoize (1986). Genera Graminum Grasses of the world. *Kew Bulletin Additional Series XIII,* London.

Grosser, D. and W. Liese (1973). Present status and problems of Bamboo classification. *Journal of the Arnold Arboratum,* **54**: 293-308.

Holttum, R.E. (1956). The classification of bamboos. *Phytomorphology,* **6** : 73-90.

..................(1972). *Letter to Prof. (Dr.) W. Liese*, dated 16 Feb. 1972 cf. Grosser and Liese (1973). *Ibid.*

Majumdar, R. (1989). In. S. Karthikeyan, S.K. Jain, M.P. Nayar and M. Sanjappa. *Fl. Ind. Enum. Monocot*. 274-283, BSI, Howrah.

Munro, W. (1868). A monograph of the Bambusaceae. *Trans Linn. Soc. Lond.*, **26** : 1-157.

Naithani, H.B. (1990). Nomenclature of Indian species of *Oxytenanthera* Munro. *J. Bombay Natural Hist. Soc.*, **87:** 439-440.

Pattanath, P.E. and K. Ramesh Rao (1969). Epidermal and Internodal structure of the culm as an aid to identification and classification of bamboos. *Recent advances in the anatomy of tropical seed plants. Proc. Ist Nat. Symp. Muslim Univ. Aligarh*. 179-196.

Soderstrom, T.R. and R.P. Ellis (1988). The woody bamboos (Poaceae: Bambuseae) of Sri Lanka; A Morphological Anatomical Studies. *Smithson. Contrib., Bot* No. **72** : 1-75.

Widjaja, E.A. (1987). A revision of Malesian *Gigantochloa* (Poaceae-Bambusoideae). *Reinwardtia* **10** : 291-380.

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(V)

EFFECT OF PLANT DIFFERENCES ON THE INITIAL MORTALITY OF LAC INSECT *KERRIA LACCA* KERR.

Indian lac insect *Kerria lacca* Kerr. thrives on a large number of host plants which are widely distributed throughout the country. Nymphs of the insect, after emergence from the mother cell settle on the succulent twigs of the host plants and complete their life cycle by feeding at the same site. In almost all the host plants considerable mortality varying from 75 to 90 per cent have been recorded to take place till maturity of the insect. Very high extent of mortality recorded soon after settlement of the insects, referred to as initial mortality, is not due to parasites or predators, as they are responsible for mortality only after the first moult. In the present investigation, attempts have been made to study the effect of inter plant differences of the host plant *Moghania macrophylla* (bhalia) causing initial mortality of the lac insect.

To study the plant effect on the initial mortality of lac nymphs after the settlement, twenty bhalia bushes were inoculated with brood lac and samples were drawn to record the mortality ten days after inoculation. Five shoots (bearing lac insect colony) from each bhalia bush were sampled at random and mortality counts recorded from five sectors (2.5 cm length) of each shoot.

Table 1 depicts the per cent mortality of lac nymphs on bhalia host plants. The highest mortality was observed to be 34.20 per cent which is highly significant than the mortality recorded on most of the plants. On the other hand the lowest mortality (9.78 per cent) is significantly lower than that recorded on most of the host plants.

Table 1

The effect of host plant (bhalia) on the mortality of lac nymphs (arranged in descending order of mortality)

Sl. No.	Mortality (%)
1.	34.20
2.	32.63
3.	25.05
4.	24.49
5.	23.95
6.	22.84
7.	22.73
8.	22.30
9.	21.86
10.	20.79
11.	20.30
12.	17.85
13.	17.08
14.	16.85
15.	16.28
16.	15.81
17.	15.57
18.	15.57
19.	12.04
20.	9.78
C.D. at 5%	5.66
C.D. at 1%	7.44

Srivastava (1983) and Bhagat (1988) while reporting this initial mortality of the lac nymphs due to starvation have not assigned the reasons of such a high

population of insects facing the problem of starvation, despite enough natural food in the form of best shoots of the host plants available to them. Before settlement the lac nymphs crawl on the twigs/shoots in search of suitable feeding sites, penetrate their proboscis at several sites and finally select the most suitable spot, start feeding and secreting lac resin from the very next day. Significant variation in initial mortality from plant to plant clearly indicate the phenomenon of antibiosis of the host plant. The insects overcoming this phase of antibiosis survive till maturity, provided other biotic and abiotic factors remain favourable.

Further studies in this direction to estimate the heritability of this factor of host plants causing initial mortality is in progress. The study will be of great practical significance in selecting out host plants causing low initial mortality of lac insects. In case, such differences are nongenetic, special plant management practices can be adopted to reduce this high mortality.

Acknowledgements

The authors are thankful to the Director for his keen interest in the work. Thanks are also due to Shri R.K. Swansi and Shri D.W. Runda for their technical assistance.

References

Bhagat, M.L. (1988). Field studies on the initial mortality of lac insect *Kerria lacca* Kerr. in relation to host plants. *Indian Forester,* **114** (6) : 339-242.

Srivastava, D.C. (1983). Studies on the factors affecting rangeeni lac insect population. *A. Rep. Indian Lac Res. Inst.* : 12-13.

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(VI)

NECTAR FEEDING BUTTERFLIES OF *DEBREGEASIA HYPOLEUCA* WEDD.

Debregeasia hypoleuca Wedd, (Urticaeae), a common, evergreen, monoceous whrub grows at an altitude ranging from 1,500-2,400 m all over the Western and Central Himalayas (Collett, 1971). In Shimla (2,100 m), the flowering takes place from mid March to mid April. Its tubular, light-pink coloured, female flowers during this time of the year secrete nectar that attracts a wide range of insects for feeding and pollination.

A survey was conducted to find out the nectar feeding butterflies of this plant during its flowering period in the year 1994. Eight species of lepidoptera were recorded which are listed below along with their relative abundance on this flowering shrub.

Family-1 : Nymphalidae :
Vanessa carduii (Linnaeus): The painted lady. Common.

Vanessa indica (Herbst): the Indian red admiral. Common.

Vanessa cashmiriensis (Kollar): The Indian tortoise shell. Very common.

Argynnis lathonia (Linnaeus): The Queen of spain fritillary. Not too common.

Family-2 : Pieridae (Yellows and Whites) :

Colias fieldi (Menetries) syn. *C. croceus* (Fourcroy) : The dark clouded yellow. Common.

Artogeia canidia (Sparrman) syn. *Pieris canidia* (Sparrman) : The Indian cabbage white. Common.

Family-3 : Satyridae (Browns) :

Rhapicera schakra (Kollar) syn. *Pararge schakra* (Kollar) : The common wall. Common.

Family-4 : Lycaenidae (Blues) :

Lycaena phleas (Linnaeus) : The common copper. Rare.

Reference

Collett, Col. H. (1971). *Flora Simlensis* Third edition. Bishen Singh Mahendra Pal Singh, Dehra Dun. 468-469.

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Arun Pratap Singh

From the Indian Forester - One Hundred Years Ago

THE INDIAN FORESTER
February, 1896 (pp. 41-43)

AN INJURIOUS INSECT IN JODHPUR

Under the above heading, Pandit Gokal Das, Supt. of Forests, Jodhpur, in the October Number (1895) of the *Indian Forester*, asked for suggestions as to the methods to be employed in the destruction of a locust-like insect reported to be attacking a plantation of young mango trees. The insect in question was forwarded by him to the Entomological Department of the Indian Museum, Calcutta, for identification and for suggestions as to means to be taken for its destruction. It was identified by the Deputy Superintendent as *Pylotropidius didymus*, an Orthopterous insect of the family Acrididae. He apparently made no suggestion as to means for destroying it, but mentioned that the insect had not previously been reported as destructive to agriculture. As any new attack from an insect previously unrecorded as a pest is of interest and more especially so in this case when it is the life of a young plantation that is at stake, I wrote to Pandit Gokal Das asking him if no other insects were to be seen on the mango trees at the time of the attack by the locusts and also as to date of his letter to the Superintendent, &c. My reason for these questions was that I thought damage might to due to one or other of the two Heterocera, *Nutada velutina*, Kollar, a Limacodidae or *Artaxa limbata*, Butler, of the family Liparidae which both attack the foliage of the mango. In answer, the Pandit stated that no other insects appeared to be attacking the trees except occasionally white ants. He very kindly forwarded me at the same time some specimens of *P. didymus* and some young mango plants which were said to have been killed by the insect. Some of the Sangtra plant was also received, which is stated to be growing amongst the mango and to be unattacked. A cursory examination of the stems of the mango trees showed me that the damage was not due to the work of White Ants. The damage was first noticed about the second week in May and the letter to the Superintendent at the Calcutta Museum was written on May 23rd. These dates are important as helping to give colour to the statement that *P. didymus* is the aggressor.

I am unacquainted with the life history of the insect in question and can find no mention of it in the Indian Museum Notes, but the above is the typical life-history of the family.

Pandit Gokal Das states that 'about two acres of the plantation were burnt and the ashes were sprinkled over the mango plants' and says that no more insects were found after this. This absence of the insects was more probable due to the fact that the mature ones after coupling had died off and only the egg stage was present, than to any wholesale destruction the burning of a small area would have if the attack were at all a bad one. Again he says "since writing the above, the insect has again commenced its ravages, having stripped some plants completely of all their leaves." These new insects would probably be the young brood hatched out from the eggs.

I have examined the young stems with roots sent to me : the plants were two years old,

one year in the nursery and one year in the plantation, and were from 18 inches to 4 feet in height. There is certainly no mistake as to the damage done to the young stems, the bark having been in places often completely ringed off. The stems have been attacked in three ways. On some, the bark has, as above mentioned, been singed completely round, resembling some Coleopterous attacks. On others the bark has been eaten off in great angular patches whilst on a third stem I noticed the bark was hanging in long shreds all round the wood of the young stem. No leaves were on any of the young plants received by me, though several of them had the appearance of being not long dead.

The fact that neither the young Jaman (*Eugenia jambolana*) plants which are either growing amongst the mango trees, or near by, nor the sangtra which is growing amongst the attacked plants have been touched is curious as locusts are pretty well omnivorous where plant life is concerned.

Remedies - In this case, burning the sangtra amongst the mango plantation, has the effect of ridding the area burned over of the pests, but its effect on the whole area will depend very much on the proportion of area burned over to that over which the attack is spread. It is perhaps superfluous to remark that burning operations carried out in a young plantation of trees, are not exactly compatible with the production of strong and healthy plants. In a case like the present, the remedies which I think might be tried are :-

(a) Hand-picking - Provided labour is procurable - a large number of insects should be got rid of in this way. In the cold weather invasion of 1890-91 of the locust *Acridium peregrinum* the villagers of Peshawar turned out and some eighty million young insects were destroyed at a cost of about 8,000 rupees, or 10,000 per rupee. This hand-picking should be commenced as soon as the insects are noticed on the trees so that they may be killed before their eggs are laid.

(b) Hoeing - If possible hoe up the ground after the eggs have been laid in it. The eggs thus get buried and if the young locusts do emerge they cannot force their way up through the superimposed layer of soil.

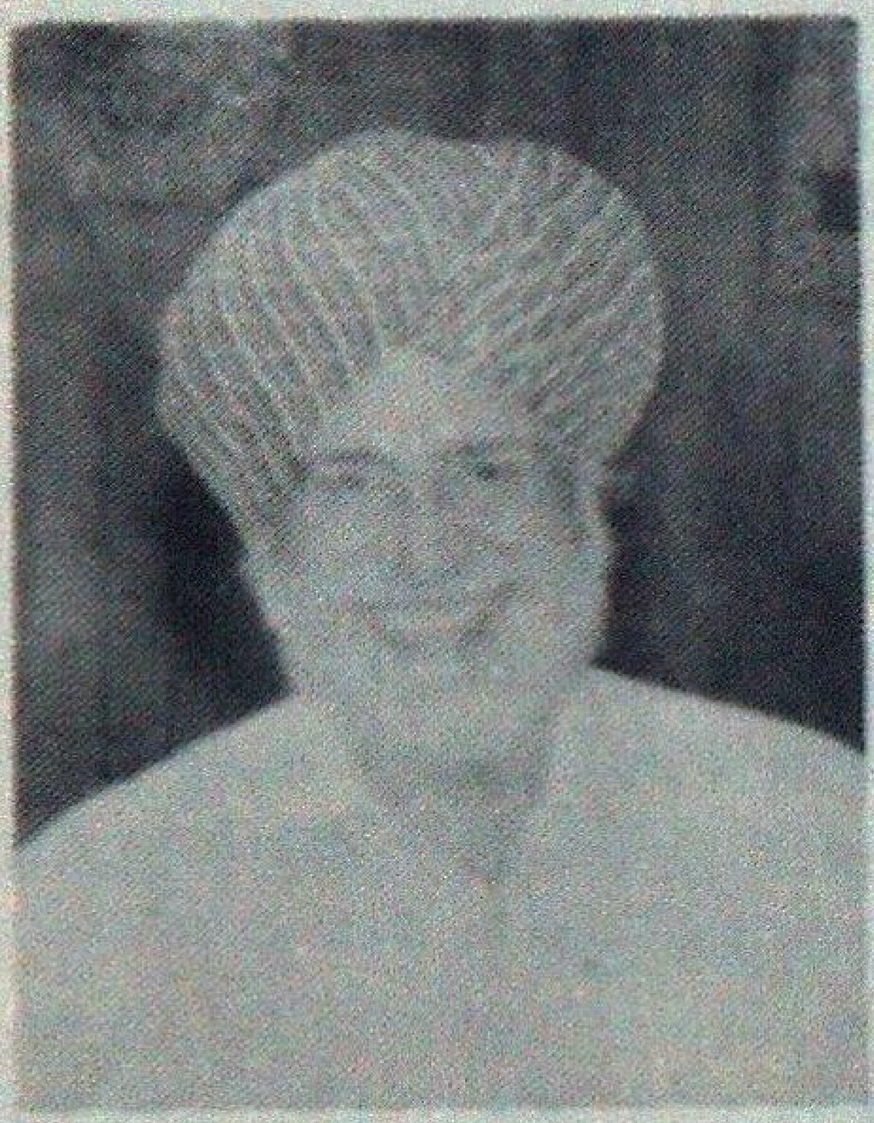
(c) Irrigation - If towards the close of the hot weather this part of the plantation can be kept under water for a period, all the young generation of the *P. didymus* present on this area, would be destroyed. After hatching, the young insects spend some days in a wingless state during which period they can only crawl.

(d) Weed Fires - If there is any wind, good weed fires giving forth a dense smoke should be made in favourable position, so that their smoke may be carried across the plantation. This will make the locusts move off the area. A search should be made soon afterwards and any stupefied ones killed.

CAMP RAIANG, TISTA VALLEY. E. STEBBING.
9th January, 1896.

OBITUARY

DR. GOPAL SINGH PURI
(18.8.1915 - 18.4.1995)



It is with deep sense of profound sorrow that we convey news of the sad demise of Dr. G.S. Puri on 18-4-95, after a massive heart attack, at Liverpool (U.K.). In his passing, the world has lost a most illustrious Geologist, Paleabotanist and above all, a distinguished Ecologist.

Dr. Puri was born on the 18th of August 1915, at Kallar (now in Pakistan) and had his earlier education in Punjab and obtained his Master of Science (Hons.) in Botany with distinction. After his Ph.D, with Prof. Birbal Sahni, Dr. Puri got interested in the Ecological sciences and later worked with Prof. W.H. Pearsel on the "Plant-Soil relationship in the forest communities with emphasis on litterfall and soil organic matter". Sir. H.G. Champion, who was one of the examiners of Dr. Puri for the Ph.D. thesis submitted to the University of London, U.K., highly approved of the studies of Dr. Puri.

After his return to India, Dr. Puri joined the prestigious Forest Research Institute, Dehra Dun as the first Forest Ecologist. During his stay at F.R.I., he developed a very strong school in Forest Ecology that greatly influenced the development of ecological sciences. Dr. Puri's contribution, with Shri N.P. Mohan of the H.P. Forest Department, on successional studies of Oak-conifer forests, still remains a landmark study in Himalayan Forest Ecology. Dr. Puri also traveled far and wide in the pursuit of ecological studies and contributed extensively to the ecology of different forest covers. Among the various contributions of Dr. Puri, the first ever text book in Tropical Ecology in India, *'The Indian Manual of Plant Ecology'* was published in 1954 and then the *Indian Forest Ecology* published in two volumes during 1960.

Although Dr. Puri shifted to U.K. in 1966, he had developed a great interest in human ecology. He wrote profusely on the theme of integrating science, technology, humanities and environment for the welfare of human society.

Prof. Puri leaves behind his wife Mrs. Kailash Puri, an eminent Punjabi writer and three children. In the demise of Dr. Puri we have lost a true ecologist.

May his soul rest in peace. - Editor

GAZETTE NOTIFICATIONS

ANDHRA PRADESH GAZETTE

Shri K. Jaganmohan Rao, I.F.S. (72), Chief Conservator of Forests (Vigilance) O/o. the Prl. Chief Conservator of Forests is transferred and posted as Chief Conservator of Forests (Wildlife), O/o. Prl. Chief Conservator of Forests, Hyderabad vice Shri T. Ramakrishna, I.F.S., Chief Conservator of Forests transferred.

Shri T. Ramakrishna, I.F.S. (72), Chief Conservator of Forests (Wildlife) is posted as Chief Conservator of Forests (Production), O/o. the Prl. Chief Conservator of Forests, Hyderabad vice Shri S.K. Das, I.F.S. (72) Chief Conservator of Forests transferred.

Shri Mohd. Sultan Mohiuddin, I.F.S. (72), Chief Conservator of Forests (J.F.M.) O/o. the Prl. Chief Conservator of Forests is transferred and posted as Chief Conservator of Forests (Development), O/o the Prl. Chief Conservator of Forests, Hyderabad vice Shri B.V. Rao, IFS (72).

Shri S.K. Das, I.F.S. (72), Chief Conservator of Forests (Production) is posted as Chief Conservator of Forests (Vigilance), O/o. the Prl. Chief conservator of Forests, Hyderabad vice Shri K. Jaganmohan Rao, I.F.S. (72).

Shri S.D. Mukherji, I.F.S. (68), Spl. Secretary to Government (Forests), E.F.S. & T. Department is transferred and posted as Chief Conservator of Forests (J.F.M.) O/o. the Prl. Chief Conservator of Forests Hyderabad vice Shri Mohd. Sultan Mohiuddin, I.F.S. (72) Chief Conservator of Forests transferred.

The services of Shri A.P. Awasthi, I.F.S. (66), Chief General Manager, A.P. Forest Development Corporation Ltd. are withdrawn from the Corporation and he is posted as Special Secretary to Government (Forests), E.F. & T. Dept. vice Shri S.D. Mukherji, I.F.S. (68) transferred.

Shri S.V. Rao, I.F.S. (72), Chief Conservator of Forests (Development), O/o. the Prl. Chief Conservator of Forests, Hyderabad is transferred and his services are placed at the disposal of the A.P. Forest Development Corporation Ltd., Hyderabad for appointment as Chief General Manager, A.P. Forest Development Corporation Ltd. on deputation, vice Shri A.P. Awasthi, I.F.S. (66) repatriated.

CHANDIGARH GAZETTE

Shri H.S. Sohal, I.F.S. (AGMUT : 87) is appointed the Deputy Conservator of Forests and Chief Wildlife Warden in the Union Territory of Chandigarh Administration in the newly created post.

HIMACHAL PRADESH GAZETTE

The Governor, Himachal Pradesh, is pleased to order the transfers/postings of the following I.F.S. Officers in public interest with immediate effect :-

1. Shri N.K. Mathur, I.F.S. (1968) Chief Conservator of Forests is posted as Chief Conservator of Forests, Working Plan and Settlement, Shimla against vacant post.
2. Shri D.C. Thakur, I.F.S. (1969) Conservator of Forests is posted as Executive Director, HP State Forest Corporation.
3. Shri C.D. Katoch, I.F.S. (1970) Chief Conservator of Forests is posted as Chief Conservator of Forests (Project) against vacant post.
4. Shri R.C. Sharma, I.F.S. (1965) who is presently holding the charge of Managing Director, H.P. State Forest Corporation will draw his salary against the post of M.D. HPSFC till further orders.
5. Shri S.B. Islam, I.F.S. (1979) Conservator of Forests is posted as Conservator of Forests (Planning) with Addl. Charge of Conservator of Forests (R&D).
6. Shri R.K. Gupta, I.F.S. (1978) Conservator of Forests is posted as Conservator of Forests (Working Plan), Dharamsala against vacant post. He shall also hold Addl. charge of the post of Director, IGCP, Palampur, till further order.
7. Shri R.K. Kapoor, I.F.S. (1978) Conservator of Forests is posted as Conservator of Forests, Chamba vice Shri A.C. Karwasra.
8. Shri A.C. Karwasra, I.F.S. (1971) Conservator of Forests, Chamba is posted as Conservator of Forests (Wild Life), Shimla (newly created post).
9. Shri Parveen Thapliyal, I.F.S. (1980) Conservator of Forests is posted as Conservator of Forests, Nahan vice Shri Joginder Singh.
10. Shri Joginder Singh, I.F.S. (1971) Conservator of Forests, Nahan is posted as Director, State Landuse Board. He will hold addl. charge of Conservator of Forests (Working Plan) Shimla.
11. Shri A.K. Gupta, I.F.S. (1975) Director SLUB, is posted as Director South, H.P. State Forest Corpn. Ltd., Shimla against vacant post.
12. Shri J.S. Walia, I.F.S. (1979) Conservator of Forests, is posted as Conservator of Forests, Rampur vice Shri Krishan Dass.
13. Shri Krishan Dass, I.F.S. (1976) Conservator of Forests, Rampur is posted as Conservator of Forests, Bilaspur vice Shri R.K. Sood.
14. Shri R.K. Sood, I.F.S. (1970) Conservator of Forests, Bilaspur is posted as Director (Marketing) H.P. State Forest Corpn. Ltd.
15. Shri Shyam Lal, I.F.S. (1977) Director (Marketing) H.P. State Forest Corporation, is posted as Conservator of Forests, Shimla.
16. Shri H.S. Kingra, I.F.S. (1980) Conservator of Forests is posted as Conservator of Forests (Headquarters) (newly created post).

17. Shri M. Narayanappa, I.F.S. (1985) D.C.F. IWDP Kandi (Hills) Solan is posted as D.F.O., Nahan against vacant post.
18. Shri U.K. Banerjee, I.F.S. (1983) Associate Prof. Dr. Y.S. Parmar University of Hort. & Forestry Solan is posted as D.F.O., Solan against vacant post. He shall also hold addl. charge of D.F.O. Nalagarh till further order.
19. Shri G.R. Sahibi, I.F.S. (1989) D.C.F. Kandi Project Nahan is posted as D.C.F. Wild Life, Shimla.

On the recommendations of the Screening Committee, the Governor, Himachal Pradesh is pleased to order the promotion of the following Indian Forest Service Officers as Conservators of Forests in the pay scale of Rs. 4500-150-5700 with immediate effect :-

1. Shri J.S. Walia, I.F.S. (1979) on regular basis.
2. Shri H.S. Kingra, I.F.S. (1980) on regular basis.
3. Shri S.S. Negi, I.F.S. (1980) on deputation with ICFRE, Dehra Dun proforma promotion.

KARNATAKA GAZETTE

The Government of Karnataka hereby accepts the notice dated 30th January 1995 of Shri A.N. Yellappa Reddy, IFS (KTK 64½) an officer borne on the Karnataka Cadre of Indian Forest Service under rule 16(2) of the All India Services (DCRB) Rules, 1958 and he is permitted to retire voluntarily from service with effect from 20th November 1995 (AN).

FORTHCOMING FORESTRY/ENVIRONMENT PROGRAMMES (1996)

29 April - 1 May 1996
Fourth Circumpolar Symposium on Remote Sensing of Arctic Environment. Copenhagen, Denmark.
Contact : Prof. P. Budmandsen.
Fax : +45 45 993 1634.

21-23 May 1996
Second International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences. Colorado State University, Fort Collins, Colorado, U.S.A. Sponsored by IUFRO. Contact the Chair : H. Todd Mowrer, Spatial Accuracy Symposium, Rocky Mountain Forest and Range Experiment Station, 240 W. Prospect, Fort Collins, CO 80526-2098, U.S.A.

September, 1996
Effect of Environmental Factors on Tree and Stand Growth. Dresden, Germany.
Contact : Prof Dr. Habil G. Wenk, Technische Universitat Dresden, Institut fur Waldwachstum und Fortliche Infomatik, Wildsdruffer Strasse 18, 0-8223 Thrandt, Germany.

2-6 September 1996
World Heritage Tropical Forests Conference - Science for Better Management and Understanding. Cairns, Far North Queensland, Australia.
Contact : Conference Secretariat, P.O. Box 1280, Milton, Queensland 4064 Australia.

7-11 October 1996
The Monte Vertia Conference on Assessment of Biodiversity for improved Forest Planning. Monte Vertia, Ascona, Switzerland.
Contact : Dr. Michael Koehl, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL/FNP) CH-8903 Birmensdorf, Switzerland.

26-28 October 1996
Resource Inventory Techniques to Support Agroforestry & Environment Activities. Chandigarh, India.
Contact : Dr. Atul, Head Dept. of Agroforestry and Environment, H.P. Agriculture Univ., Palampur - 176 062, Distt Kangra (H.P.) India.

4-7 November 1996
International Symposium on Assessment and Monitoring of Forests in Tropical Dry Regions with Special Reference to Gallery Forests. Brasilia, Brazil.
Contact : Prof. Dr Jose Imana Enclnas. Universidade de Brasilia, Departmento de Engenharia Florestal, 70.910-90 Brasilia DF, Brazil.

25-29 November 1996
International Conference on Tropical Forestry in the 21st Century. Kasetsart University, Bangkok, Thailand.
Contact : FORTROP '96 Secretariat, Faculty of Forestry, Kasetsart Univ., P.O. 1054, Bangkok 10903, Thailand.

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4. **Annotated Bibliography on *Dalbergia sissoo*, Roxb.**
   (Symbol No. ICFRE-25) by N.K. Joshi, P. Bhatnagar Malbika Ray and A.K. Sharma
   Price Rs. 150/-
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   Price Rs. 240/-
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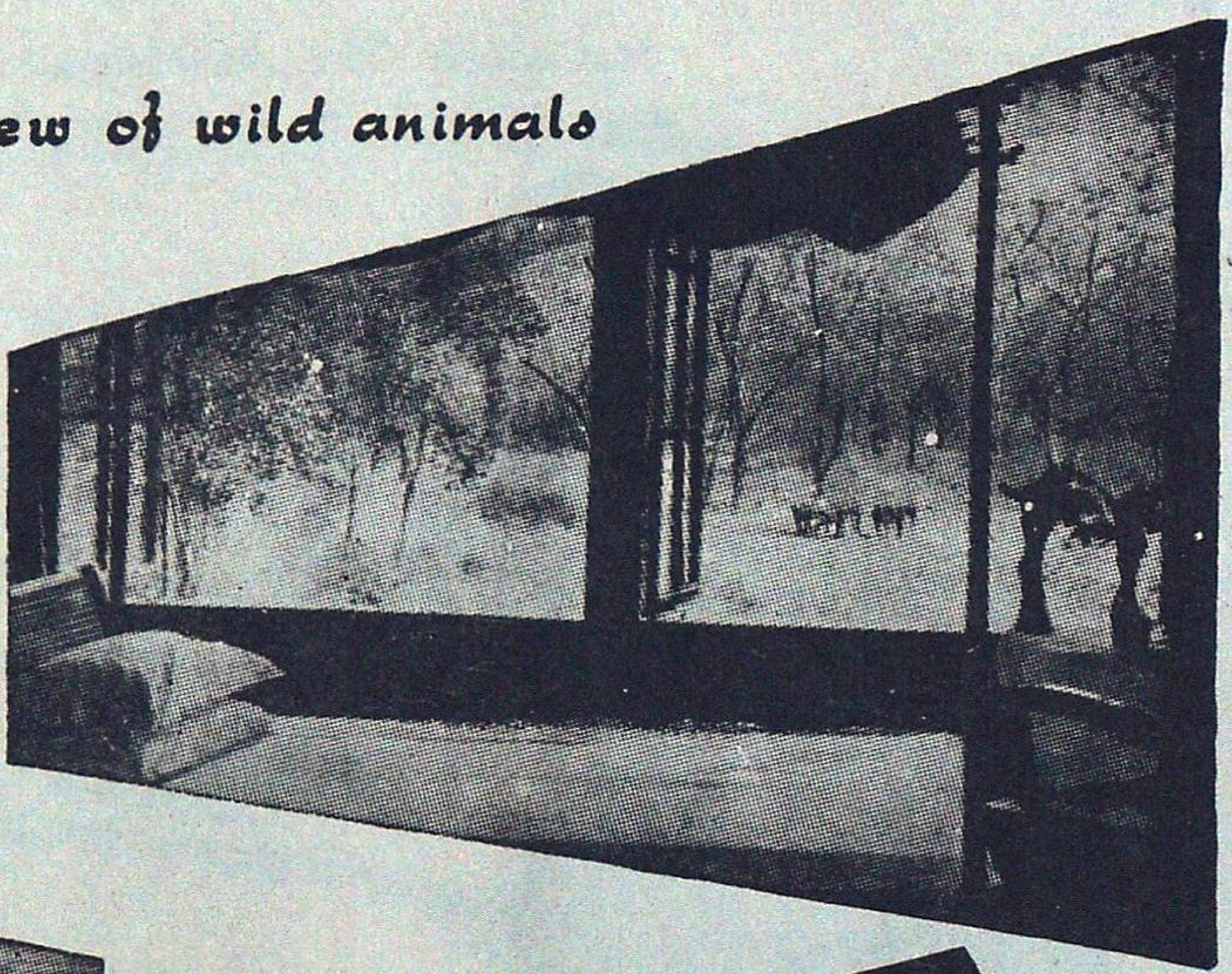

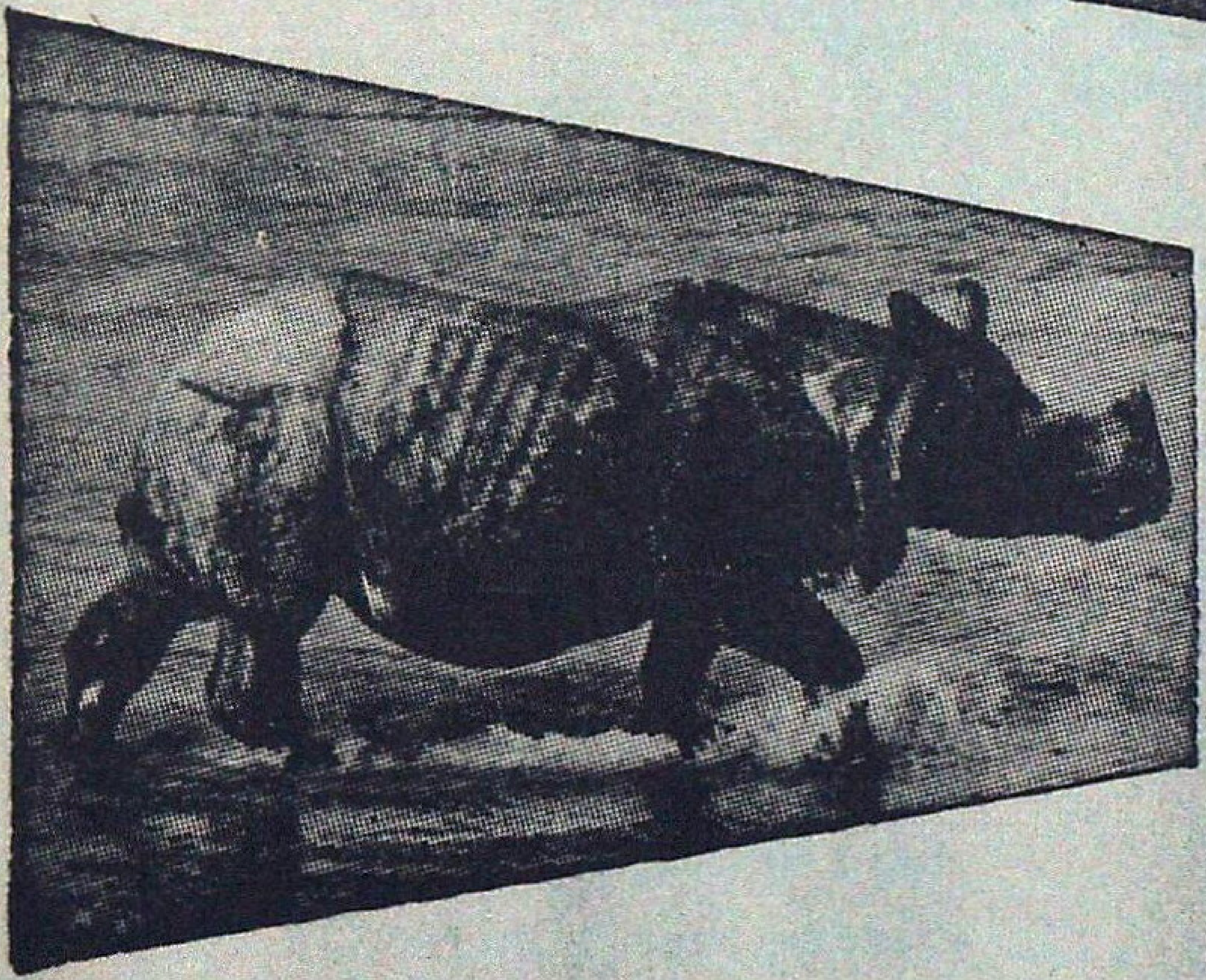

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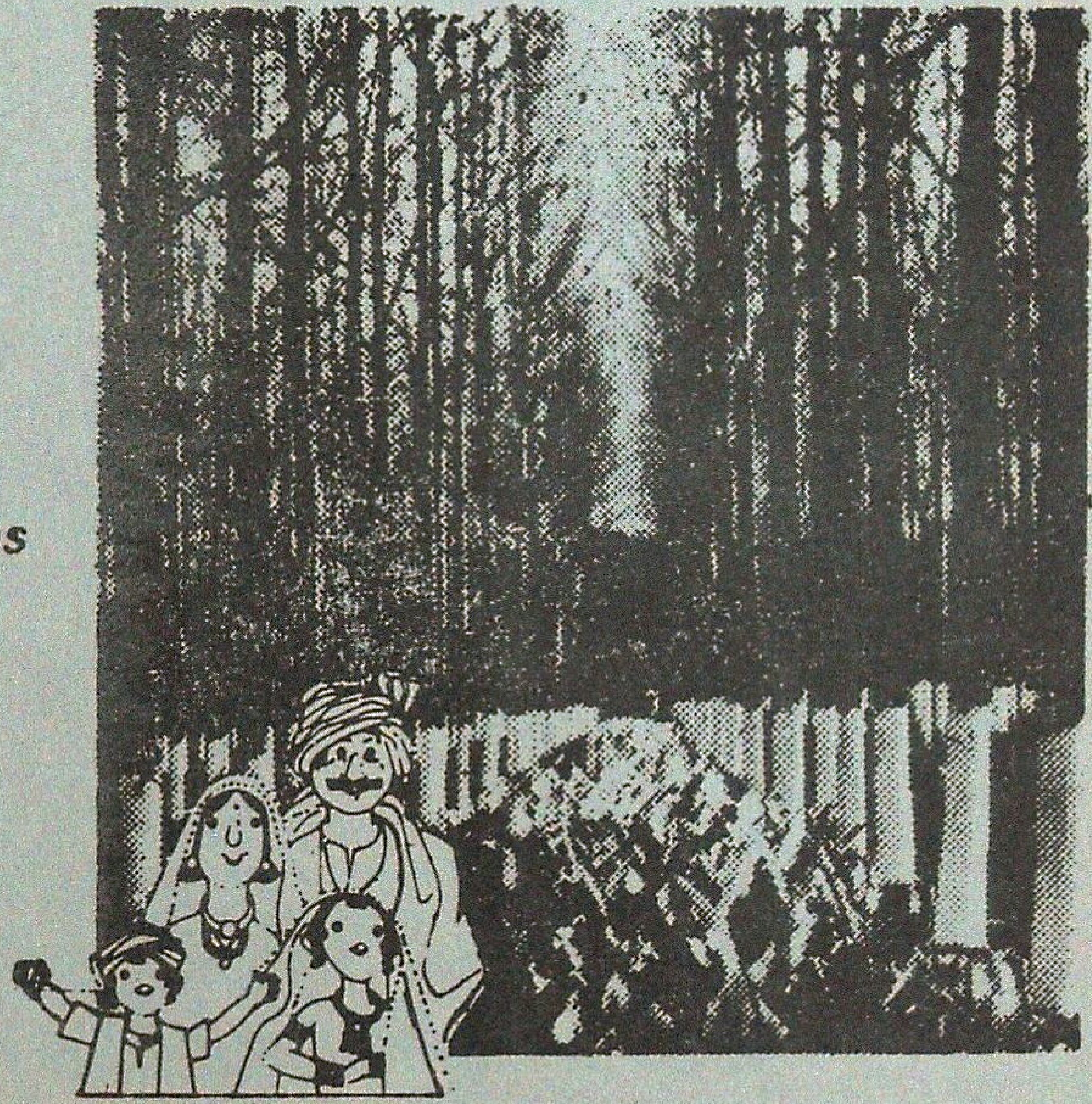

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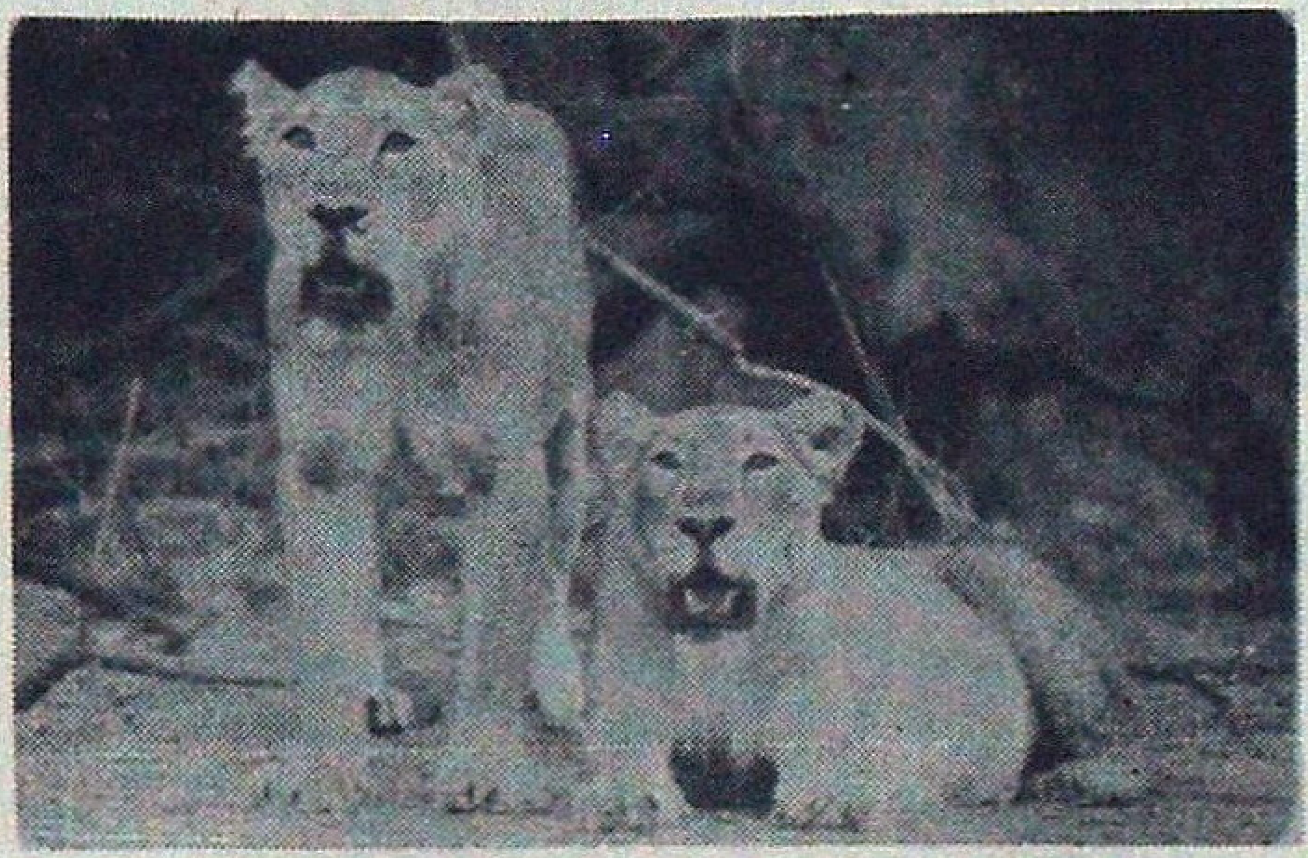

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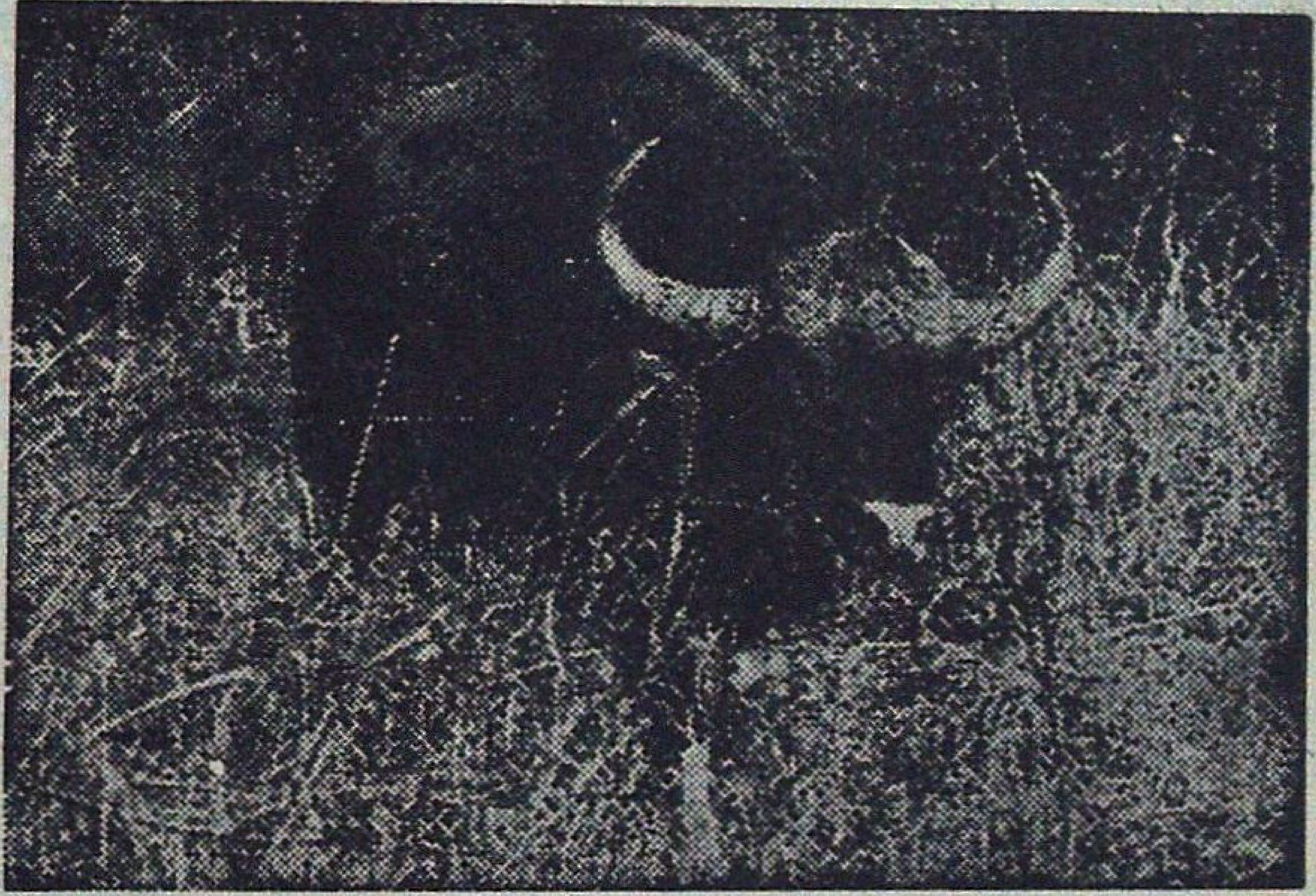

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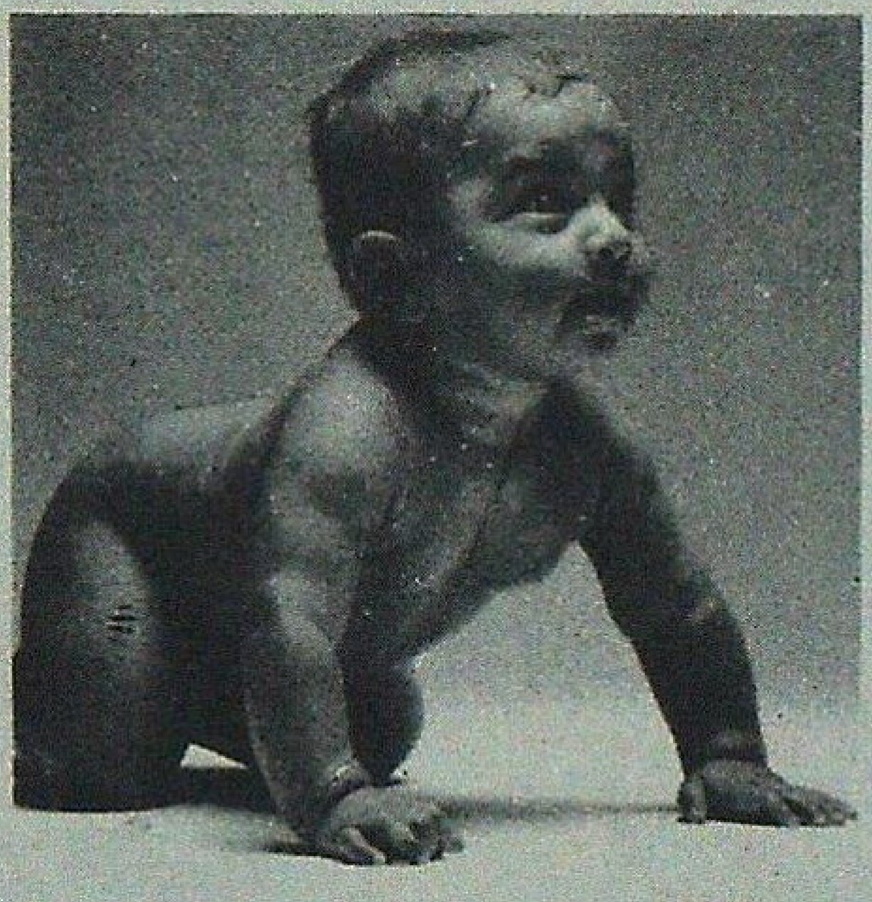

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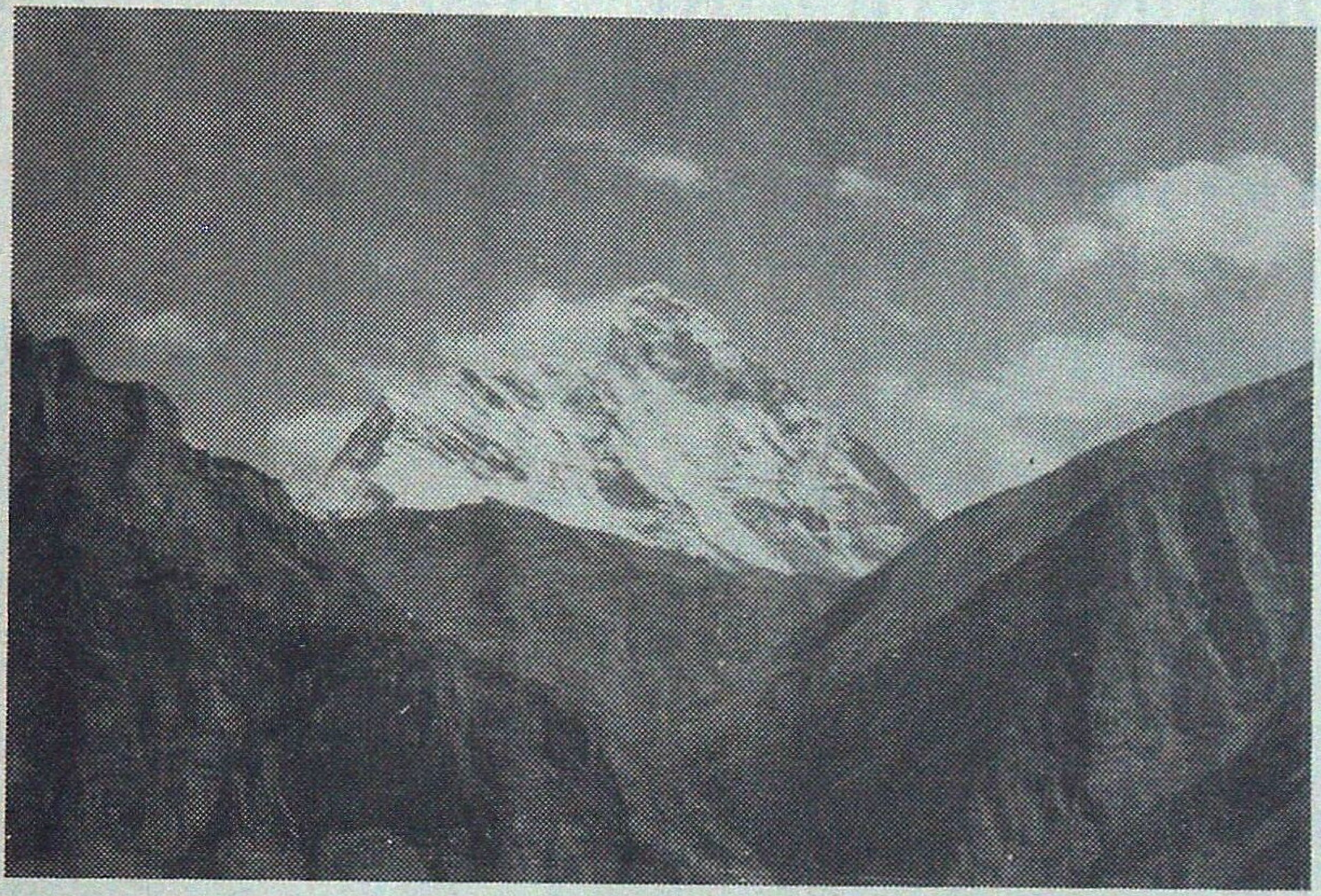

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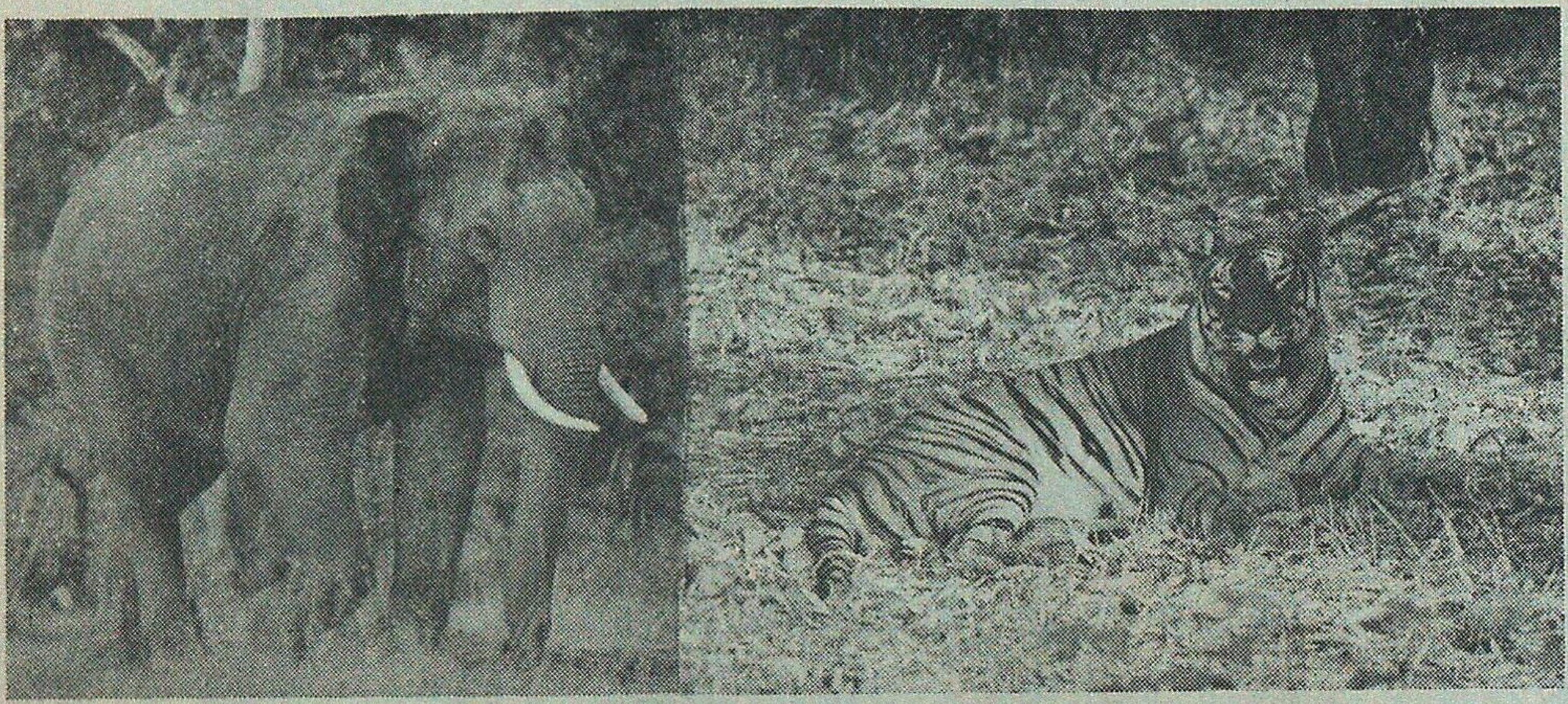

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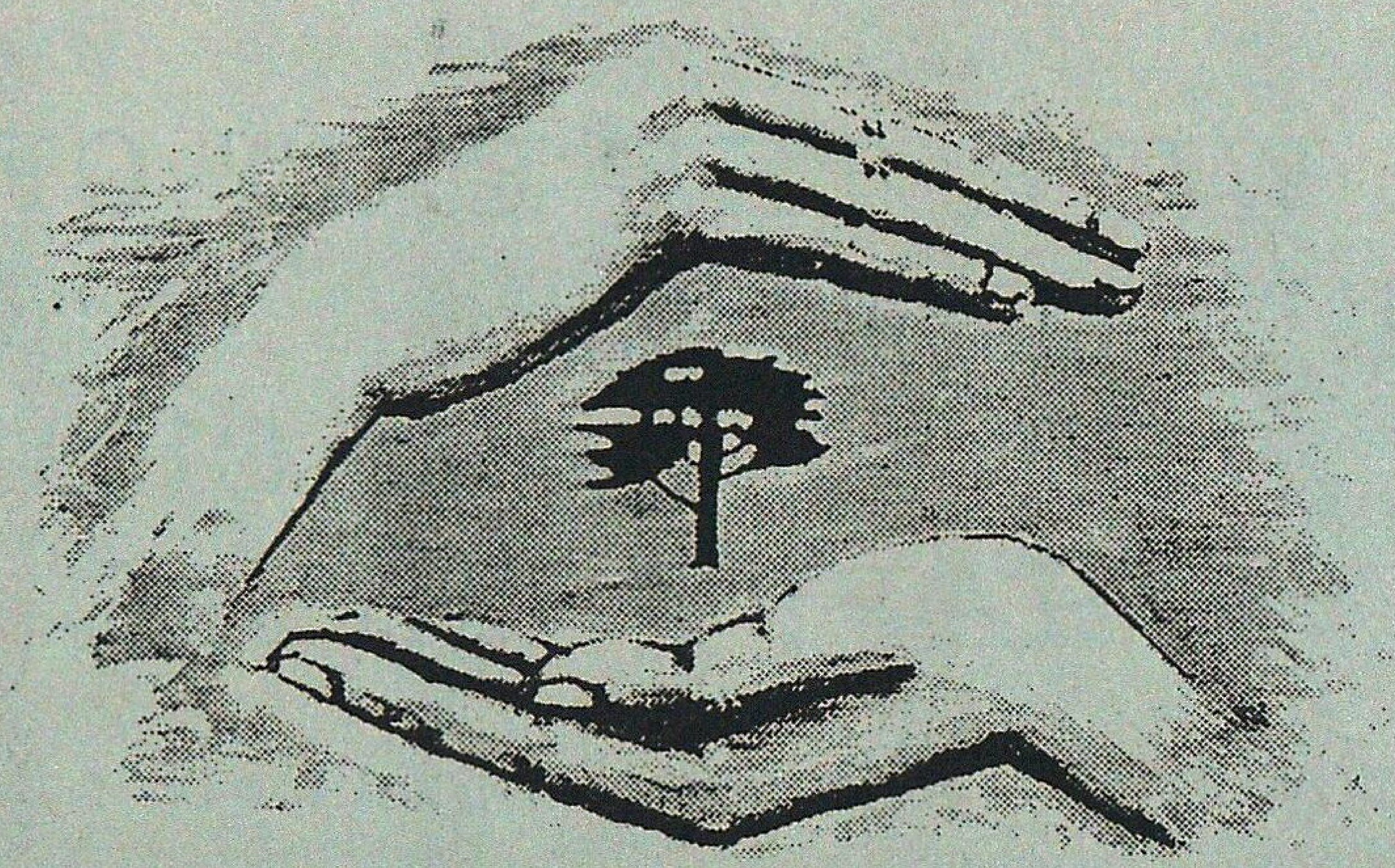

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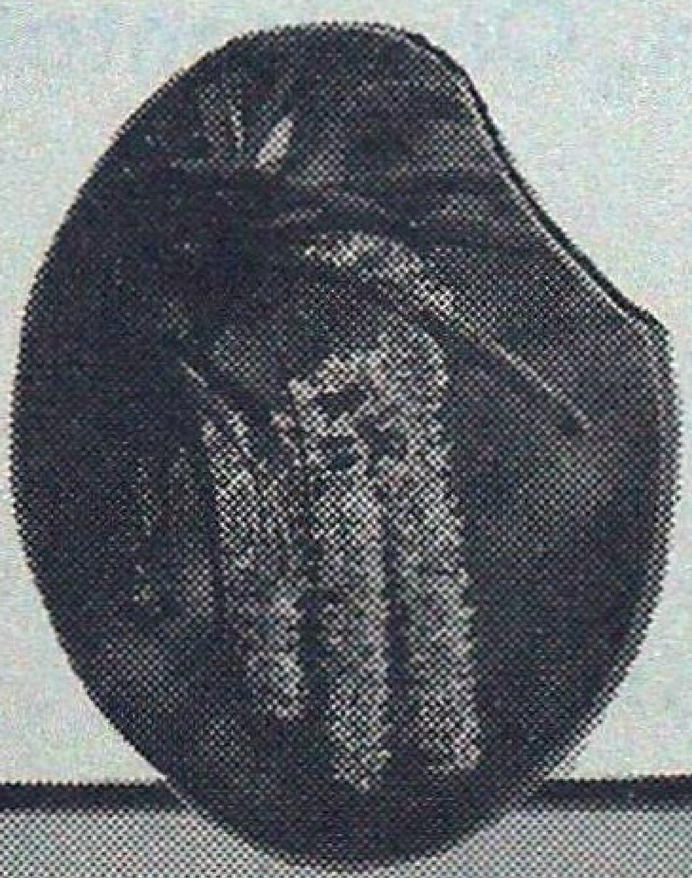

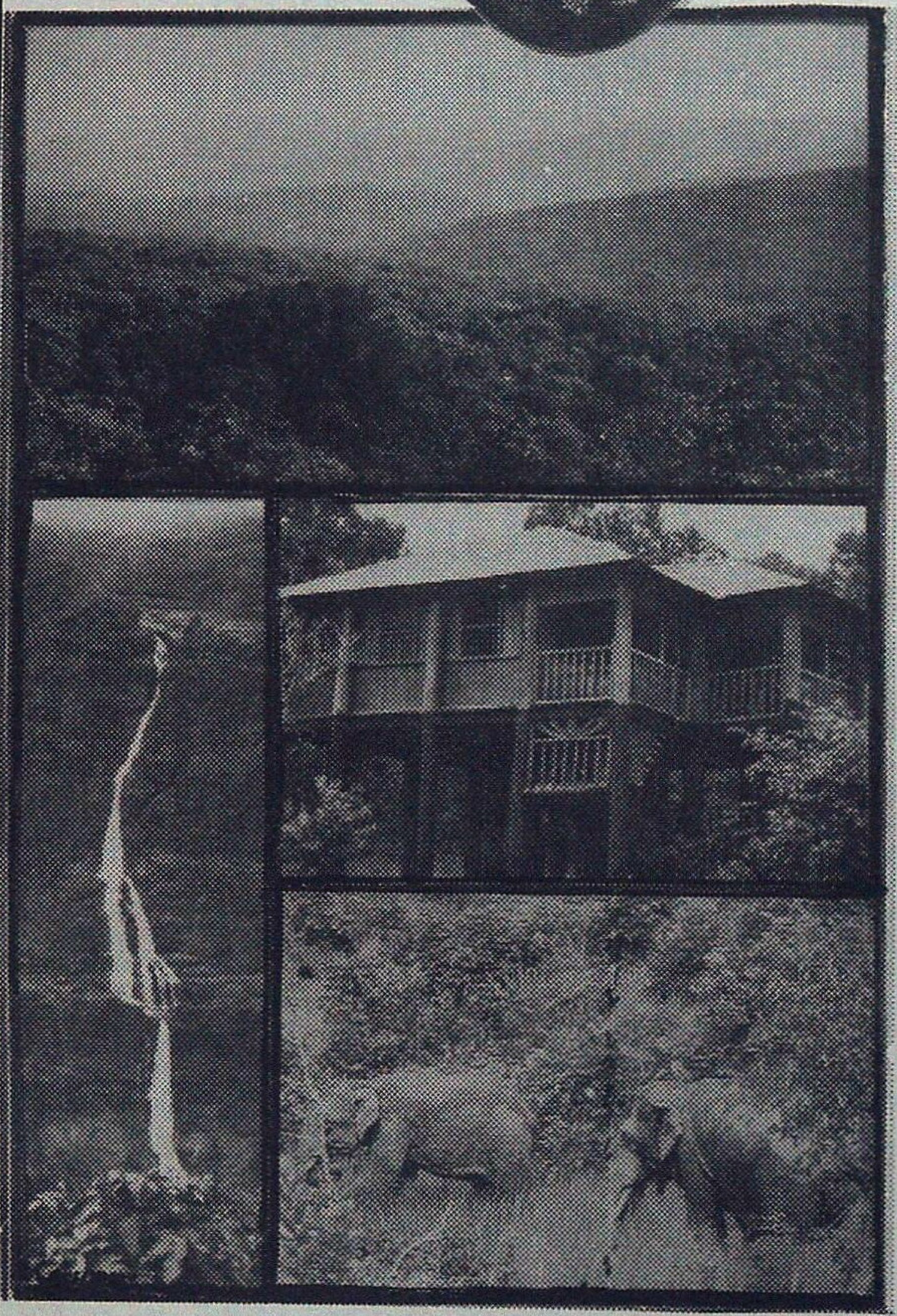

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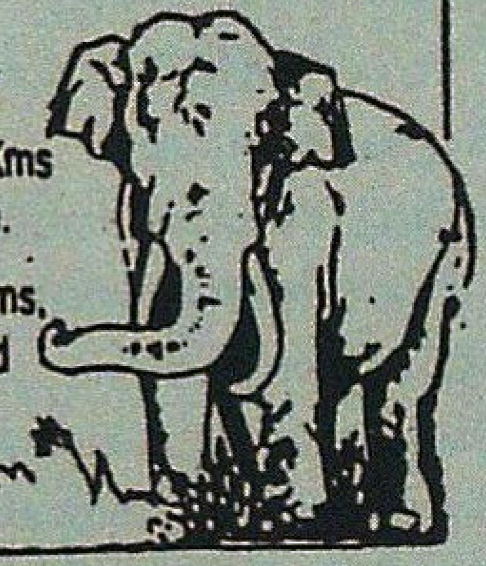

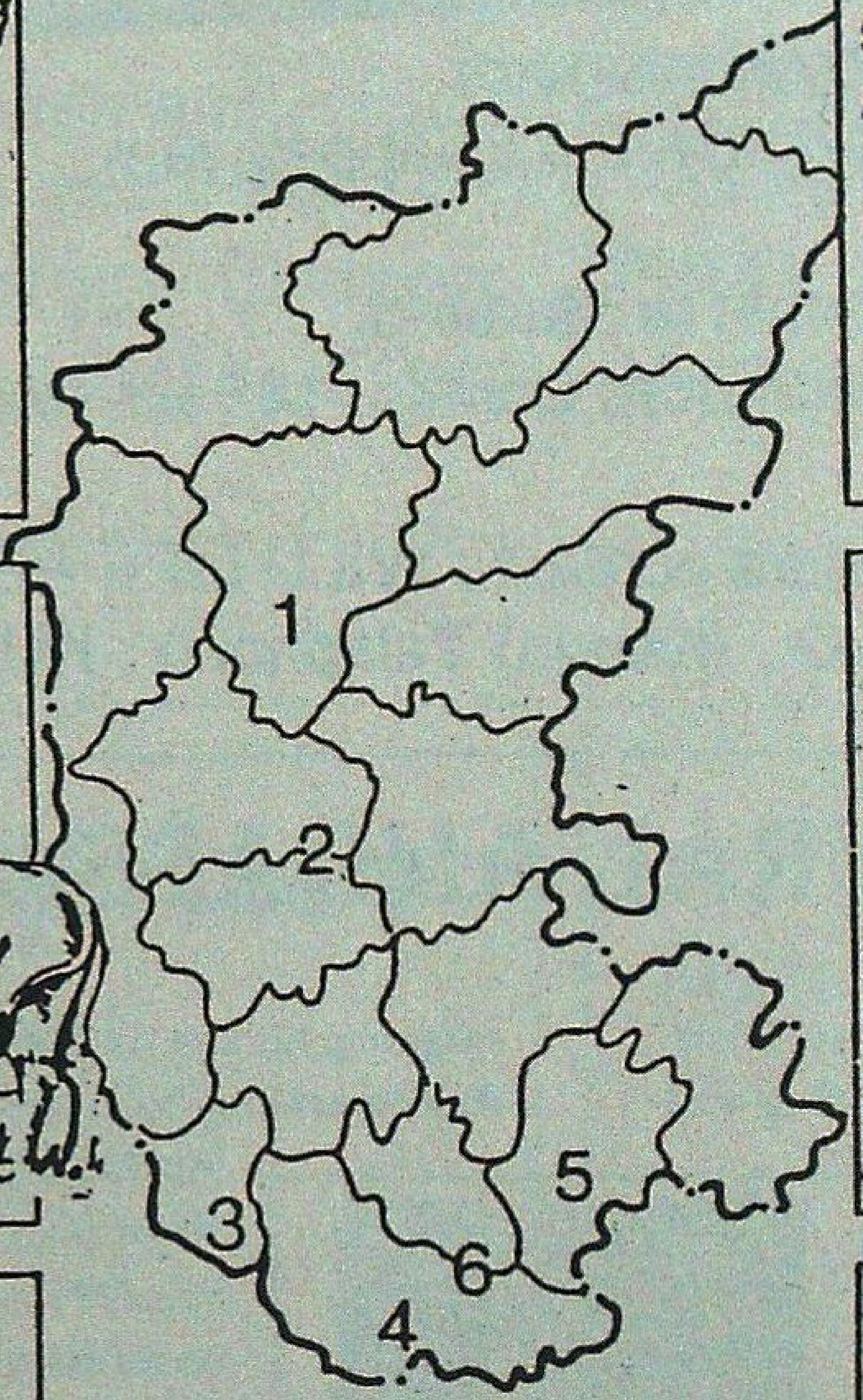

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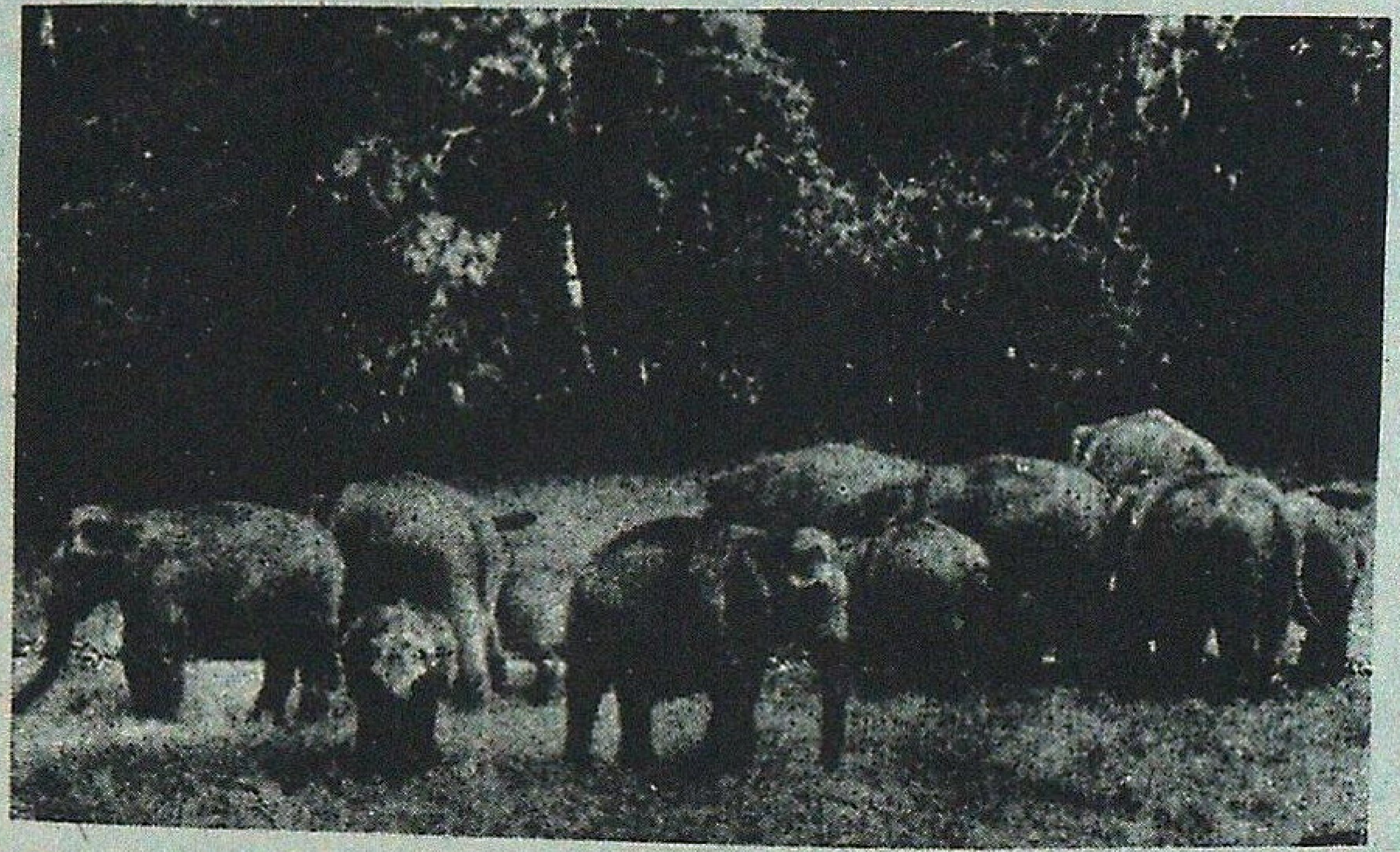

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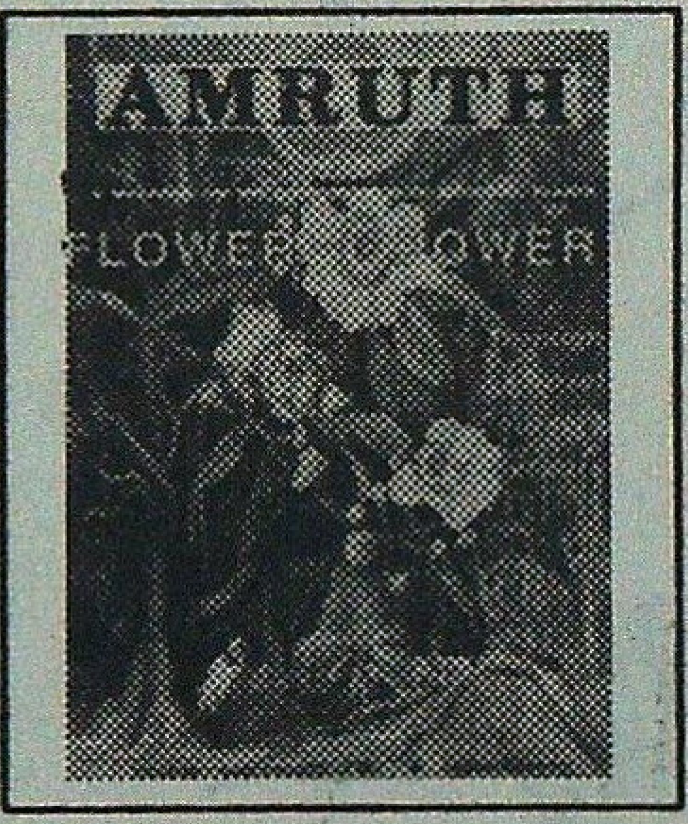

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Forested areas play an important role in the conservation of environmental quality through conservation of soil and water resources and biological diversity.

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